University of Washington

ARBORETUM BULLETIN

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Concerning this issue...

The *Arboretum Bulletin* is continually striving for a balance of articles that will interest our many different readers.

In recent issues of the *Bulletin,* Seattle City Arborist Marvin Black discussed Seattle's street tree program. Continuing our exploration of urban plantings, we bring you an article by Mrs. Pendleton Miller on environmental stress and those plants which may be used in stressful conditions. Mrs. Miller explains new concepts and modern understanding of plant responses to urban stress.

The significance of this article is emphasized by two symposia planned for the late fall and winter of 1978-79. In November a program on urban forestry will have taken place in Washington, D.C., under the joint sponsorship of the University of New York at Syracuse (College of Environmental Science and Forestry), the United States Forest Service and the National Consortium for Environmental Forestry Studies. Fifty speakers and representatives from educational and public agencies of all fifty states will have been present to point up the great need for public education in this field. In addition, on January 26 a symposium, "The Politics of Trees," is being held in Seattle. See page nine for details.

Gardeners will be interested in the plant lists at the end of Mrs. Miller's article. A number of unusual or unfamiliar plants is described. For gardeners, also, is the second part of Brian Mulligan's description of his and Margaret's garden in Kirkland.

Caroline Bledsoe and R.J. Zasoski discuss the sludge program currently being conducted in experimental plots at the Arboretum.

And in contrast to more practical subjects, we have R.F. Stettler's philosophical examination of how we perceive plants.

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COVER
Garrya elliptica 'James Roof'
flowering in the Arboretum in late winter.
(See articles on *Garrya* in summer issue 41(2),1978)

Photo: Brian O. Mulligan.

A flowering branch of *Styrax japonica* from tree illustrated on page 3. Photo: G. Pirzio-Biroli.

Challenge to Maintain the Green Scene

*MRS. PENDLETON MILLER**

Seattle and the coastal Northwest in general give the impression of being a lush green vegetative area. Our urban communities and newly developed metropolitan centers feature accessory landscaping. Freeway, park and street tree plantings have become a first priority in city, county and state planning. All this has come about in the universal effort to relieve the tension and stress of modern living.

Therefore, why need we be concerned when we are so amply endowed? In looking beneath the surface of this idealistic image we find a revelation of many problems in evidence now, with more forthcoming unless an extensive educational program is undertaken to avoid them.

It was less than 10 years ago that we began to hear about threats of air pollution in the Northwest — disbelievingly. Now we have a more concerned population supporting the efforts of our many conservation and wild life organizations in their crusade to protect at least a portion of earth in its natural state.

In sizing up air pollution as a single factor in the Northwest, we can hope that we shall never suffer the degree of pollution from heavy industry which has invaded so many of our major cities. Yet it is entirely possible that air pollution will increase on a global scale because of the invasion of the atmosphere in general and over which, of course, we have no control.

To date our severest air pollution problem is from automobile exhaust fumes. In areas exposed to full sun these gases are affected chemically, turning O_2 into ozone. Where ozone is prevalent, we find a declining list of plants able to tolerate this form of pollution.

The evidence of air pollution affecting nearly all plants in the Seattle area is recognizable to scientists, even if it may go undetected by the majority of laymen.

However, pollution alone does not necessarily cause mortality in plants unless they are exposed to extreme pollutant gases. A plant is weakened to the degree that it suffers from pollution, and in time it can become less resistant to other environmental stresses and to disease.

Among these stresses are: dehydration of foliage from wind funneled by adjacent structures; general abuse by pedestrians, automobiles and

*Mrs. Miller is one of the most knowledgeable horticulturists in the Seattle area. She has been instrumental in the creation of many of our beautification projects including the Freeway Lid Park and Operation Triangle which she refers to in the present article. She has recently returned from a visit to China and is enthusiastic about the public planting that is being undertaken there.

animals; glare from cement or glass; poor drainage; root rot from being planted too deeply; recession of new soil; excess mulch above the crown of the plant; compaction of the soil preventing absorption of air and water; and an inadequate maintenance program. These are just a few of the possible environmental stresses. In addition the plant itself may be a poor choice for the prevalent conditions or may be excessively susceptible to disease. Air pollution in the Northwest is moderate on a relative scale, yet it is sufficiently prevalent to weaken our plants. Combined with other weakening factors it can result in poor plant performance if the material is not environmentally tolerant. Best to prepare for increased pollution with the use of tolerant plant material.

Following are some of the planting practices which we must consider:

SOILS AND SITE PREPARATION

The Northwest is one of the few areas where a city has been built on glacial strata. This means that water is traveling between layers of clay. The foundations of buildings and residences in addition to expanses of surfaced areas such as community centers, freeways, et cetera, will change the natural geological character of surrounding areas. The previous pattern of underground action becomes blocked or rechanneled. This explains why the more building we have on our shoreline bluffs, the more we are subject to landslides due to the resultant forces of new channels of water activity when they meet. These slides cannot be brushed aside as "acts of God." They are man-made conditions which cause radical changes in the natural geographical status.

It is of primary importance to maintain a strong program in designating land for rain absorption for the stability of our soil conditions.

Unfortunately the criteria for site preparation used by public agencies is based on specifics established by the United States Department of Agriculture. They were devised prior to the day of pollution and absence of natural soil conditions. In no way do these specifics apply to the variance of horticultural conditions throughout the United States. They are merely basic and should be treated with "amendments" made on a local level with consideration being given to the local variances and micro-climates. From this source comes the current practice of spreading six inches only of minimum-specification topsoil on top of our hardpan as a home for a plant!

Some common failures in practice related to soils are:

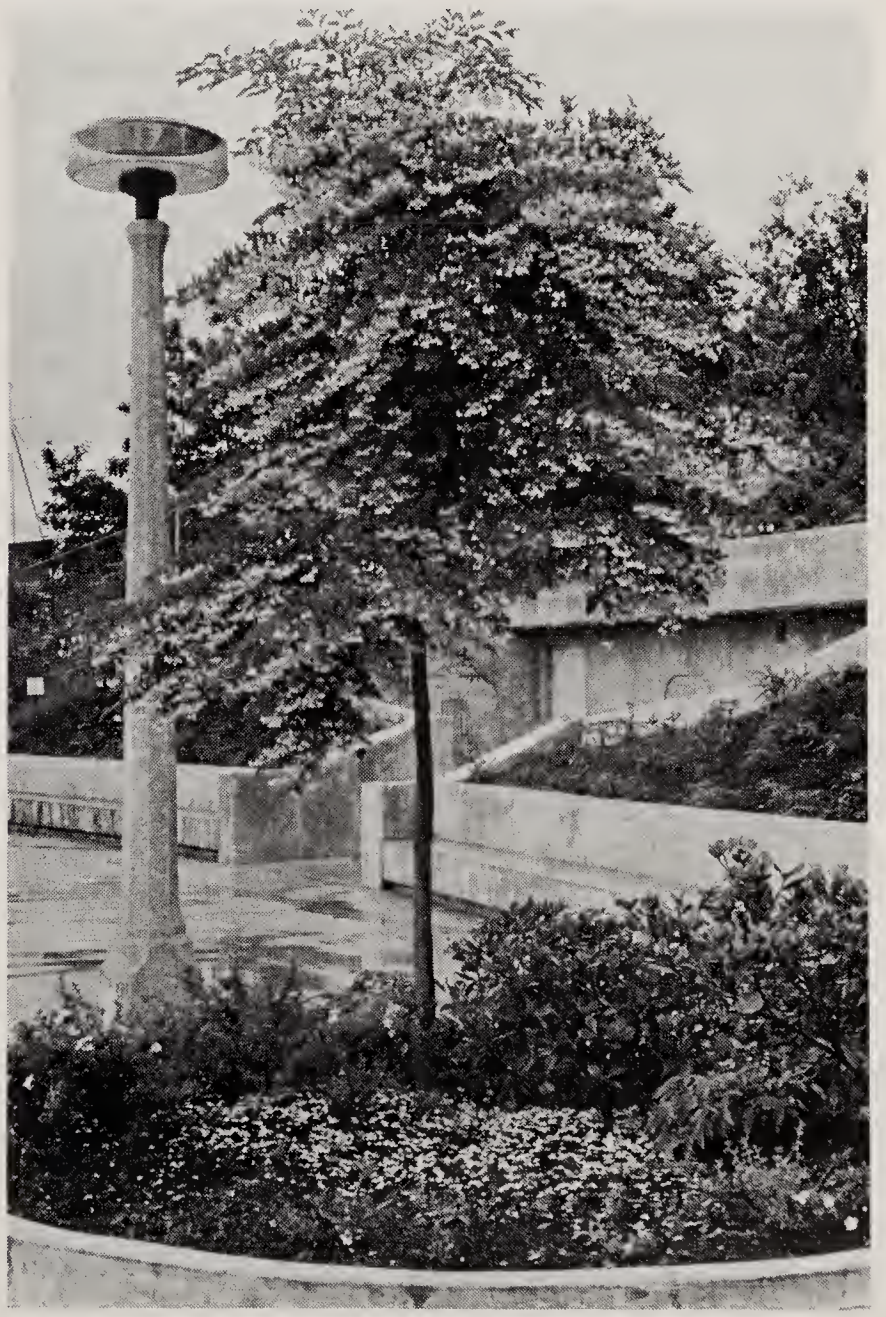
It is a mistake to assume that a hillside means good drainage. If the drainage medium is not provided to carry water below the surface, the water merely runs down the surface washing off the topsoil and without providing water for root absorption by plants.

Placing a plant on top of a mound without concrete support is a false drainage concept. Again, the water is not adequately absorbed, runs off, and during a drought the roots can be burned and dried out from exposure.

Provision for drainage with one or two access lanes to a street gutter or by the use of pea gravel is inadequate. In our area pea gravel is inclined to join the clay and create aggregate cement. One- and one-half-inch coarse gravel is cheaper and more satisfactory.

Street trees and shrubs planted in containers that do not have drainage from the base will eventually rot from the resultant stagnant water.

***Styrax japonica* blooming profusely at the Government Locks' fish-ladder planting. Photo: G. Pirzio-Biroli.**



***Koelreuteria paniculata*. Young tree at Government Locks' fish-ladder planting. Photo: G. Pirzio-Biroli.**

Mulching too deeply or even planting too deeply is a common error everywhere. Any time the crown of trees and shrubs is below the soil level or mulch it is an invitation for root rot, which eventually is fatal. Fertilization is not a cure; it may produce a spurt of life for another season and then the plant dies from the extra strain of responding to the fertilizer and an inadequate root system.

Large-growing street trees (depending upon ultimate size of the species) should have vaults eight feet square and ten feet deep with elaborate drainage systems and ground covers for processing the soil. This is in sharp contrast to the prevalent practice of digging holes in sidewalks, and regardless of the underground spaghetti of conduits, et cetera, throwing in a minimum amount of soil and allowing the surface to be compacted by pedestrians, thereby cutting off the source of air and water.

Plants should not be placed in a newly dug dry hole as commonly practiced. The hole should be filled with water and allowed to drain out several times to assure the plant of moist soil for root establishment and adjustment. This applies to all planting regardless of whether or not it is raining.

SELECTION OF NURSERY STOCK

Unfortunately most landscape architects feel the need for instant reproduction of their landscape plans, which narrows the choice of plant material. Much of our current public planting is less imaginative than it might be, because a majority of desirable, environmentally tolerant ornamentals can succeed only if they are transplanted when young and given several years' care, after which they become maintenance free.

Planners should avoid nursery stock which has been held overly long in an effort to grow larger lush plants in less time. Such plants are too weak to tolerate extreme temperature. Plant materials should be field grown at least one year and preferably two.

Healthy stock must be selected at all times. Plants should be inspected by a competent person in the nursery before purchase.

SELECTION AND MAINTENANCE OF SUITABLE PLANT MATERIAL

The prevalent financial approach to a landscape development must be revised. In general the bulk of the landscaping budget is specified for acquisition of the property involved, fees for landscape architect, contractor and subcontractors, with a minute percentage allowed for purchasing plant material and planting media. Usually the budget has no specific provision for a maintenance program. A budget for maintenance should be given highest priority. This determines which plant material can succeed in relation to its maintenance: lawn requires maximum maintenance; trees, shrubs and ground covers vary in their needs.

Once these decisions are made then plants must be chosen within this maintenance category which can also withstand the environmental stresses of the site, and these vary in accordance with the kind of land use, the amount of pollution and other pressures previously listed. The planting practices discussed in previous paragraphs must also be taken into consideration.

Greater maintenance expertise is needed. For example, a serious problem is canker, which is fatal to plants and can be caused by injury to the bark or improper pruning. It can be carried from one plant to another on a pair of pruning shears or a saw which has not been sterilized.

The strength and ability of a plant to cope with pollution will improve substantially when the priority consideration of a planting is the necessary ingredients for plant survival.

Four concepts are being promoted by horticulturists in meeting specific environmental and maintenance problems:

1. Larger growing trees are suggested for both street trees and parks because pollution and environmental abuse will scale down their ultimate growth. It is very difficult to convince urban forestry representatives of this fact, but it has been both proven and recommended by the New York Park Department.

2. In some areas we have roadside banks extensively covered with unsightly tangles of blackberries. Attempts to remove and replace them with other plants is not only costly but futile. It is better to assume that a two-foot cleanout is inadequate since the roots are much deeper. Controlling growth by individual treatment with chemical 245T is only temporary, and must be repeated continually, to say nothing of the inevitable reseeding from the neighboring blackberry masses. It would be far less costly to shear this blackberry (unevenly for aesthetic purposes) to vary from one to three feet, providing handsome new foliage and, of course, fruits. Shearing once every two years would be the maximum maintenance requirement. For further effect the blackberries could be interplanted with *Rosa rugosa* 'Alba.' Both of these are highly environmentally tolerant. In addition, they provide a strong natural foundation for planting cedars, hemlocks and firs, which have good pollution tolerance. Most of these rundown areas cannot be absorbed by our public agencies for development. Yet it would require so little to transform them to areas of beauty left to their own devices.

3. Perhaps a new concept, both good and timely, is the idea "natural is beautiful." Both the eye and the mind are beginning to recognize the beauty of masses of natural grass. They offer movement with the wind and provide subtle seasonal change and color. Once this natural turf is established, it can be seeded with wildflowers whereas wildflower seeds thrown on a new and exposed site are not likely to succeed. We have a broad choice of natives which can provide maintenance-free color and interest from early spring to early fall.

4. The greatest little "mother's helper" in our gardens or public plantings is the ground cover for control of weed and seed germination, to maintain a loose friable soil for rain and air absorption, to keep the roots cool during droughts by means of foliage transpiration and shade, to provide frost protection by means of air circulation control and to offer beauty as well. The greatest asset of ground cover plantings is their effectiveness in continually processing the soil; the old foliage on such species does not become detached but remains to decompose and enrich the soil.

In general, our public agencies are showing increasing sensitivity in these areas. We can be extremely grateful to Marvin Black, City Arborist (see articles in *Arboretum Bulletin,* Vol. 41, Nos. 1 and 3). He is responsible for a tremendous breakthrough with Seattle's street tree program. The Seattle Park Department is similarly becoming more receptive to horticultural input, as is the Seattle District, United States Corps of Engineers with their active program in the beautification of the Lake Washington Ship Canal.

Ophiopogon japonicus interplanted with annuals until the young plants merge. Freeway Lid Park.

Photo: G. Pirzio-Biroli.

Following is a list of some of the plants we must consider.

PLANTS WHICH HAVE BEEN TESTED FOR TOLERANCE OF URBAN STRESS

Deciduous trees and shrubs:

An incorrect but common concept of coping with pollution is the use of deciduous plants regardless of their pollution tolerance. The theory is that at worst the pollution-affected foliage will die and drop off earlier than normal if the plant is not a tolerant species. However, the foliage is needed as an air-cleaning agent, and a shortened period of bearing foliage will ultimately produce a weak tree.

Liquidambar (sweet gum). Tough tree. Since its fall color is variable, it should be selected at that time.

Acer platanoides (Norway maple). Another toughie.

Amelanchier laevis. Small tree known for its striking beauty; when in bloom, it has a profusion of fragrant white flowers interspersed with delicate young pink foliage. Drought and insect resistant. Possibly a practical substitute for the cherry trees desired by landscape architects.

Pyrus calleryana 'Bradford.' More desirable spreading branch pattern than the variety 'Chanticleer.' Pollution tolerance history: in Washington, D.C. dying cherries were replaced with *Cornus florida,* which, as they became weakened, were replaced by *P. c.* 'Bradford.' Introduced to Seattle on the Freeway Lid Park.

Koelreuteria paniculata (golden rain tree). Hardy, drought and insect resistant. Needs minimum maintenance but should be transplanted as a young tree, preferably six feet. Spreading habit; large panicles of yellow flowers in July and August. Recently used at the Government Locks' fish-ladder planting.

Oxydendrum arboreum (sourwood). Same qualifications as above. Beautiful small tree with slender racemes of white flowers in July and August and exquisite crimson and yellow fall color. Must be planted as a young tree, and flowers at an early age.

Rosa rugosa hybrids. Drought and insect resistant, maintenance free. Horizontal branching pattern, varying from 1½ to 3 feet tall. Variety of flower colors. Offers traffic control.

Salix spp. (willow). Particularly beautiful is *S. elaeagnos* ssp. *angustifolia (S. rosmarinifolia),* a tree-shrub 10 to 12 feet high and broad. Totally maintenance free. Foliage similar to rosemary — a three-inch linear leaf, deep green above and white below. Brown wand-like stems with constant gentle movement from a breath of wind.

Fothergilla major (*F. monticola*). Insect and drought resistant shrub to four feet. Interesting inflorescence, handsome foliage with striking fall color. Plants are being grown for demonstration on Freeway Lid Park.

Deciduous azaleas. Their use is touchy because, although pollution tolerant, they are subject to severe foliage burn from reflection of glare from cement/glass.

Broad-leaved evergreens:

Rhododendron spp. Although pollution tolerant, there are many restrictions for their use: they cannot tolerate the dehydration of their foliage caused by funneled winds created by building structures; they need rich, moist soil and good drainage; they are very susceptible to root rot from stagnant water.

Magnolia spp. Several varieties to choose from. The large-leaved *M. grandiflora* should not be exposed to strong wind.

Ceanothus spp. Although very tolerant, they are limited to suitable planting sites: need to be on a bank facing west exposed to hot afternoon sun; need dry conditions with excellent drainage and no watering; any companion plants must have the same requirements. *C. exaltatus* 'Emily Brown' is an ideal specimen plant, hardier than most with a beautiful habit of growth, firm branching pattern, smaller and crisper foliage, more floriferous with strong blue flowers similar to *C. papillosus*.

Myrica californica (California wax myrtle). Insect and drought resistant; a good wind break; can withstand salt spray. Forms a dense thicket with handsome glossy leaves; offers sumptuous fruit for birds.

Quercus ilex (holm oak). One of the few evergreens which can be delimbed for traffic vision. Majestic, with lush leathery deep green foliage. A slow-growing tree when young, not commonly available, and costly. One of the trees we were unable to include in the Freeway Lid Park planting, but to be added in the future.

Leucothoë davisiae (Sierra laurel). Sun or shade;

needs moist conditions. Shrub to three feet, spreading by underground runners; dark green, very glossy leaves with striking erect panicles of pure white flowers in June.

Conifers:

We should use more conifers including the dwarf varieties.

Taxus spp. These extremely tolerant trees and shrubs are unfortunately not commonly available and are more expensive. They are very slow growing, but after all, we are planting for tomorrow, not today.

Podocarpus spp. Related to yew. Among the best in Tokyo. Dwarf species: *P. nivalis* to 3 feet with 4-foot arching branches; *P. alpina* to 1½ feet, horizontal undulating branches with yew-like fruits. These plants need to be made available.

Pinus spp. *P. sylvestris* can tolerate a moderate degree of pollution. A tolerant strain of *P. strobus* is being propagated for availability soon.

Native evergreen conifers. The firs, cedars and hemlocks are all pollution tolerant. Much more successful if transplanted when young (6 to 8 feet). They should be used more extensively except where de-limbing is necessary for traffic vision.

Our hemlock is an exceptionally good tolerant tree if not exposed to strong winds. However, 12- to 14-foot trees do not transplant easily and have a record of majority loss in transplanting. This is because far-reaching surface roots require up to four years before they can become established again. A 6- to 8-foot tree will transplant with a strong majority of survival, and in the same four-year period will reach, or even surpass, the larger stock.

Ground covers:

Heuchera glabra. Hardy, evergreen maintenance-free plant. Sun or shade. Can change a sandy bank into rich humusy soil in several years' time.

Waldsteinia ternata (W. trifolia). Dense evergreen to three inches with attractive superimposed foliage and yellow flowers. Not readily available. Demonstrated on Freeway Lid Park.

Ophiopogon spp. Evergreen, grass-like, to eight inches; used as a turf substitute. Full sun or shade; spreads rapidly; maintenance free. *O. japonicus* demonstrated on Freeway Lid Park. *O. planiscapus* var. *nigrescens* is black with striking, shiny blue-black fruits.

Epimedium perralderianum. Evergreen to 14 inches; strong yellow flowers and fall color. Maintenance free; drought resistant; full sun or shade. Demonstrated successfully on an Operation Triangle.

To be added to the tolerant list are: *Zelkova serrata, Arbutus unedo, Prunus lusitanica, Tilia cordata, Rhus typhina* and *R. glabra* (effective when combined), *Ginkgo biloba, Ailanthus altissima, Fraxinus, Ilex, Berberis, Pyracantha, Cotoneaster, Mahonia* and *Vaccinium* varieties. *Mahonia aquifolium* 'Compacta' seems less susceptible to rust than other species. *Pyracantha* and *Cotoneaster* are susceptible to fire blight carried by bees from fruit trees; best to avoid fruit-tree areas.

INTOLERANT OR UNDESIRABLE PLANTS

No longer can we use pines, *Prunus* and English ivy (*Hedera helix*) everywhere. They are best used far, far away from environmental stress in the Northwest, more so than in the more arid parts of the country.

Most of the pines, with the exception of *Pinus bungeana* and those mentioned above, are

***Myrica californica* growing densely against a concrete wall in Freeway Lid Park.**

Photo: J. Pirzio-Biroli.

susceptible to air pollution and become weakened and more susceptible to disease, blight or insects (i.e., pineshoot moth). The same is true of *Prunus,* and more so, since it is susceptible to disease anyway and needs annual spraying. Once weakened by air pollution, the problems will double.

No longer acceptable is English ivy, though not the preferred smaller-leaved forms or Hahn's variety, which are less invasive. It is the one plant which thrives on air pollution. It will grow rapidly, can smother any companion plants and needs costly scything. Its roots become so strong that they can break through reinforced concrete (watch those freeway retention walls in a few years). Last but not least, it harbors rats, a current curse in many of our cities.

Others to be avoided are:

Gleditsia triacanthos (Honey locust). Originally thought to be tolerant, this species has been slower to show the effects but is now on the pollution susceptible list.

Platanus spp. (sycamore). The sycamore is a variable tree. Seedlings can produce very weak strains that may be subject to anthracnose. No one knows why anthracnose has become so extensive everywhere or what varieties of sycamore are most susceptible, but a clue may lie in the fact that sycamores have become victims of this disease in the major polluted cities of the United States and Western Europe. (For further discussion of these plants, see Marvin Black's previously mentioned article in the *Bulletin,* Vol. 41, No. 3, pp. 15-16).

Arbutus menziesii. Our handsome native madrona just simply resents all environmental stress. Its susceptibility to fungi could be caused by its intolerance of pollution or interference with the soil conditions natural to its root system. It resents lawns, thoroughfare paths or paving. Spraying for fungi merely helps sustain the tree a bit longer. Our best remaining specimens are growing in wooded areas with our native conifers for protection. The same holds true for *Arctostaphylos columbiana* (manzanita.)

PLANTS THAT SHOULD BE GIVEN FURTHER TRIAL

Styrax japonica. This deciduous species is reported to be pollution tolerant but it is relatively unknown elsewhere. It is a very beautiful small tree with a hardy constitution. Bell-shaped flowers hang beneath the branches in June.

Sophora japonica. An elegant, spreading deciduous tree, standing unscathed amidst pathetic specimens of sycamores, elms, et cetera. Used extensively in China. Tests in Seattle have been unsuccessful because of canker, but Marvin Black is experimenting further. Other cities report a 10-year period before these trees suddenly take hold. It is also a possibility that this tree needs to be transplanted when young!

Aesculus spp. (horse chestnut). One of the most easily cultivated deciduous trees. *A. parviflora* is small and spreading (eight to ten feet); its white flowers with red anthers appear in panicles during July and August. It does well in more heavily polluted cities.

Acer japonicum 'Aconitifolium.' This deciduous small tree is more tolerant than the acer palmatums. It has larger leaves coloring ruby-crimson in fall.

Sorbus reducta. Small deciduous shrub to two feet, spreading and deep red in autumn. Attractive flowers are followed by clusters of colorful berry-like red fruits, popular with birds. Hardy; insect and drought resistant; full sun; mini-maintenance. Being grown for demonstration on Freeway Lid Park.

Enkianthus spp. Deciduous trees or shrubs with a very distinct habit of growth. Tiny flowers in May and exquisite fall coloring. Several species to choose from.

Hydrangea quercifolia. Medium-sized shrub with large white panicles of flowers and deciduous oak-like leaves valuable for their magnificent autumn tints. Full sun; insect and drought resistant; available.

Disanthus cercidifolius. This medium-sized deciduous shrub resembles witch hazel; a strong accent plant with beautifully shaped leaves that turn soft crimson and claret-red in autumn. Tolerant in Japan but needs to be tried here.

Pieris taiwanensis. A medium-sized evergreen shrub with large erect panicles of white flowers in March and April. Tolerant in Japan and needs trial here. Other species of *Pieris* are also good.

Arctostaphylos spp. Some of these evergreen species are tolerant, others, not. *A. media* has shown good tolerance. *A. uva-ursi* (kinnikinnick) is a tolerant ground cover if kept some

distance away from automobile exhaust fumes. It performs best if planted on a hillside with very good drainage. If the surface soil is compacted, the foliage will turn black when beaten by winter rains; in its natural habitat it has the protection of overhead trees and shrubs.

Pinus bungeana (lace-bark pine). H. Hillier:[1] "...one of the most ornamental of all pines...the smooth grey-green bark flakes away creating a beautiful patchwork of white, yellow, purple, brown and green..." *China Reconstructed:*[2] "sturdy tree, will root in cliff crevice or barren soil — resistant to cold, heat, drought, excessive water and moisture, adapt to any kind of soil — resistant to air pollution particularly sulphur dioxide — good for industrial cities — requires no care — good timber for furniture and tools — fragrant oil from seeds — been planted in China for 800 years — more extensively now. Needs to be ten years old before transplanting."

To be added to the list for trial are the stewartias, *Halesia carolina, Trochodendron aralioides,* and *Parrotia persica.*

There are many tolerant plants as well as plants which should be tested for tolerance which I am not attempting to cover here. A number of them have been reviewed in Marvin Black's article in the previous issue. This has been more of a horticultural "crusade."

What is more important is that there are many plants which have pollution and environmental tolerance in varying degrees and many others which have not been tested. The scientists in this field of research are constantly publishing their findings. The American Horticultural Society Environmental Horticulture Committee has undertaken to publish a continually revised brochure listing the findings of these scientists as well as plant-performance reports from amateurs throughout the country. It is a list of environmentally tolerant ironclads and does not attempt to cover material in relation to more favorable areas such as ours. However, research projects such as this are invaluable if we are to continue to have the benefit of planting in our urban areas for cleansing the air as well as enjoying relief from the psychological pressures.

Hopefully, someday we will have a demonstration plot of environmentally tolerant ornamentals with each species accompanied by a list of its tolerance factors and the horticultural requirements. It would solve the difficulties a landscape architect, student or amateur gardener has in visualizing the ultimate shape and form of an unfamiliar plant by looking at young nursery stock. In addition the landscape architect is unlikely to order plants that are not readily available in nurseries and nurserymen cannot afford to grow unfamiliar plants they cannot sell.

It should have become very clear that, rather than feeling discouraged because of the restrictions imposed by air pollution and other environmental pressures, the plant kingdom is enormous, and nowhere else on the globe can such a wealth of ornamentals be grown as in the coastal Northwest. It is merely a challenge to recognize and accommodate those plants that will succeed for us. ▲

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[1]*Hilliers' Manual of Trees and Shrubs.* 1971. Hillier and Sons, Winchester, England.

[2]This article appeared in a periodical, *New China,* published by the People's Republic of China.

THE POLITICS OF TREES is the title of a symposium on urban tress now (as of press time, mid-October) in the planning stages. It will be under the auspices of the Western Chapter, International Society of Arboriculture, Northwest Region, and will be co-sponsored by the U. of W. Arboretum. The symposium will be open to the public and will be held all day on January 26, probably on the University of Washington campus. For further information call Seattle City Arborist, Marvin Black, 625-2725, or the Arboretum Office, 543-8800.

See also the editorial "Concerning this issue..." for information about an additional program that was held in November on the all-important subject which Mrs. Miller has discussed in the preceding pages.

Photo: Brian O. Mulligan.

Leaves from a Collector's Notebook

BRIAN O. MULLIGAN

Acer grosseri var. *hersii*

This native of northeastern and central China is one of that group of smaller maple trees with striped bark which are so attractive in the winter months. This is particularly true in their earlier years when this character is most pronounced. Others in the same category are *Acer davidii,* native in many provinces of China, *Acer capillipes* from Japan and the moosewood of eastern North America *(Acer pensylvanicum).*

Acer grosseri var. *hersii* was apparently discovered on several occasions, first by the Italian missionary Father G. Giraldi in northern Shensi in 1897, also by the Reverend Hugh Scallan in the same year and again in 1899, and by C. Silvestri in Hupeh, central China, in 1907. Josef Hers, after whom it was named by Alfred Rehder in 1922, found it in April 1919 in Honan, the province immediately north of Hupeh. Two years later he was able to obtain seeds and send them to the Arnold Arboretum at Boston, where plants were successfully raised and from which it was distributed. Hers also sent seeds to the Arboretum at Les Barres in France, and there I was able to photograph a specimen in June 1973, although perhaps this was not the original tree. Since the translation of its Chinese name is "Green bark Linden," this character seems to have been recognized also in its native country.

Amongst the maples of this group, Section Macrantha, it is distinguished by the medium-sized, finely-serrated leaves, generally measuring six to ten by five to seven cm, with a cordate base and a pair of acute to short-acuminate lateral lobes and an elongated acuminate central lobe. In *Acer grosseri* the lateral lobes are very short and not acuminate, and the central lobe is less elongated. The slender petioles of var. *hersii* are pale green, three to five cm long, and small tufts of rusty brown hairs are usually present on the underside in the axils of the veins, especially when young. Fall leaf color varies from yellowish to orange with individual trees, but in *A. grosseri* it is usually a light orange tint and the leaves may remain on trees of the species in the Arboretum until early December in some years; this is not the case with var. *hersii.*

Trees of the latter can be seen in the Arboretum on the west side of Arboretum Drive north of Rhododendron Glen, and there is a fine specimen in the north portion of the Fortunei Series section. Another thriving specimen, planted in Woodland Garden in 1968, originated from seeds of a tree in Durand-Eastman Park, Rochester, New York, from Hers' introduction (No. 2800).

PRESIDENT'S MESSAGE

The improvements in the Arboretum, as proposed in the Jones & Jones Master Plan Update, are coming closer to fruition. The Environmental Impact Statement has been completed and, at this writing, is being printed. A thirty-day review period follows, including scrutiny by the Arboretum Foundation, with final review by City Council and the University after that.

Rebuilding of the teahouse in the Japanese Garden could commence any time there is assurance of adequate security and maintenance of the grounds there. Inasmuch as the teahouse was a gift from the City of Tokyo to the City of Seattle, it is incumbent upon the latter to provide the security measures needed. Funds for security and maintenance were included in first drafts of the Seattle budget, but were reduced and then finally eliminated by budget reviews. Efforts continue to restore these budget items.

The Foundation's Board of Directors at its September meeting voted to examine the feasibility of the Foundation's funding partially the salary of a director of the University's Arboretum program, such funding to be for a specific period of five years. Consultations with the University were authorized and have started. A committee has been formed and the Foundation membership will be kept advised. The University, on its part, is reviewing its entire Arboretum program, both current and planned. A panel of eminent arboretum and botanical garden directors is providing advice and support.

The foregoing subjects certainly provide enough material for a busy and exciting year. However, I do not wish to have us exert great effort only to be faced with disappointment as has happened in the past. Your board, and I in particular, will strive toward goals already set by the Foundation membership.

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Books for Christmas Giving

Loretta Slater, Arboretum Foundation Book Chairman, reminds our members that all books recently reviewed in the *Bulletin* are available through her and also that Grant's book on landscaping has at last been reprinted by the University Press in paperback.

REMEMBER: A 10 percent discount is available on all books purchased through the Arboretum Foundation by its members. Call Mrs. Slater at (206) 232-0456.

A New Name for *Leucothoë fontanesiana*

In a recent article,[1] Professor Norman Melvin III[2] clearly shows that this species from mountain regions of the Southern Appalachian chain (from southern Virginia to northern Georgia) was first described as *Andromeda Walteri* by Karl Willdenow in Berlin in 1809. This fact is confirmed by the existence of a specimen still in the herbarium at Berlin with Willdenow's own label and name on it, which was illustrated by a photograph accompanying the previously mentioned article. The proper name for this shrub is therefore *Leucothoë walteri* (Willd.) Melvin.

The entry in the University of Washington Arboretum catalogue of woody plants is incorrect in referring *Leucothoë catesbaei* (Walter) Gray to *L. fontanesiana,* as this plant has been formerly known. Professor Melvin points out that *L. catesbaei* is identical with *L. axillaris* (Lam.) D. Don. This species is native in coastal regions of the southeastern United States from southern Virginia to Louisiana and is, therefore, somewhat less hardy than *L. walteri.*

The two species are not always easily distinguished from one another in gardens. However, *Leucothoë axillaris* possesses acuminate, usually longer and narrower leaves with more serrations than *L. walteri.* The inflorescences of the former are longer with more numerous flowers, and the sepals are narrower. Details on these points can be found in an illustrated article by P.S. Green in *Arnoldia,* Vol. 23, No. 6 (August 1963).

B.O.M.
July 6, 1978

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1. *Castanea* (Journal of the Southern Appalachian Botanical Club), Vol. 42, No. 4 (December 1977).
2. Department of Botany, Miami University, Oxford, Ohio.

Emily Haig (Mrs. Neil Haig)

With the recent death of Mrs. Neil Haig, the Arboretum lost a longtime and steadfast friend.

Emily Haig wore many different hats. Widely known, and particularly so on the West Coast, for her accomplishments in the area of conservation, she was equally concerned with areas very close to home.

In 1953 Mrs. Haig was able to have the whole of Foster Island declared a bird sanctuary. She wrote many articles on birds for various publications, one of which appeared in the *Arboretum Bulletin* in the fall of 1953.

In 1958 as Chairman of the Special Projects Committee for the Arboretum Foundation, Mrs. Haig reactivated the dream of a Japanese garden in the Arboretum. Working closely with many others toward its completion, she was tireless in her efforts and ever ready with encouragement and support when needed. Her continuing interest as the garden matured was a source of inspiration to many.

As a member of the Board of Directors for many, many years, her contributions were many and varied. Emily Haig will be long remembered by those fortunate enough to have known her and worked with her as a warm and talented friend, one who shared her wealth of knowledge and left a legacy of beauty to us all.

THYRA SORRELLS (MRS. K. W.)

REMEMBER: Grant's *Garden Design* is now available to Arboretum Foundation members for $8.95 (with members' discount). Order from Loretta Slater (206) 232-0456.

Growth and Nutrition of Forest Tree Seedlings in Sludge and Composted Sludge

*C.S. BLEDSOE and R.J. ZASOSKI**

Recycling is a key concept in this time of ecological awareness. Many state, local and national agencies want to recycle municipal sewage sludge in beneficial and safe ways. Sludge recycling through land application has many potential benefits and few negative aspects. Municipal waste can be a good organic fertilizer, because it contains concentrations of such nutrients as carbon, nitrogen, phosphorus and potassium. Sludge can improve soil tilth, soil fertility and soil water holding capacity. Sludge is a mixture of domestic and industrial wastes, and some sludges may contain high levels of heavy metals or other potentially toxic chemicals. Seattle's sludge is typical of municipal sludge with moderate industrial input and contains lower to average heavy metal concentrations (Table 1). Sludges also contain some pathogenic bacteria and viruses, which are commonly associated with human wastes. Forests appear to be good sites to apply sludge since forested areas reduce the chances of human contact and remove metals and potential pathogens from the human food chain.

At times sludge may be called simply sludge, or sewage sludge, "Milorganite" (the trade name for Milwaukee's sludge), "Nu-Earth" (Chicago's trade name), wastewater sludge or municipal organic waste. Over five million dry tons of sludge are produced each year in the United States, and a five percent yearly increase is anticipated. Sludge disposal is becoming an increasing problem.

Federal regulations concerning sludge disposal have become more stringent, and freshwater disposal of sewage solids has essentially been discontinued by U.S. cities. Currently, it is estimated that 15 percent of the U.S. municipal sludge is disposed of by ocean dumping, 60 percent is relegated to incineration or land fills, and 25 percent is recycled through land application to agricultural or forest crops (1). Disposal of METRO (Municipality of Metropolitan Seattle) sludge is accommodated by hauling 60 percent to land fill at Cedar Hills, applying 30 percent to forested land and distributing the remaining 10 percent to miscellaneous applications (such as composting). The lawn at Gas Works Park in Seattle was established in composted sawdust and sludge.

An interest in finding a practical, safe and useful outlet for metropolitan Seattle's sludge has resulted in a joint project between the College of Forest Resources, University of Washington, and METRO. In September 1973 a major research program initiated a series of studies on dewatered sludge utilization in Northwest forests. This article will discuss one aspect of the sludge utilization program — a nursery-bed study begun at the Washington Park Arboretum in the spring of 1978. Other aspects of the sludge research program are being carried out at the College of Forest Resources' experimental forest near Eatonville.

This nursery-bed study was designed to measure and compare the growth and nutrient content of six different forest tree species grown in various sludge and soil mixtures. We know that different forest tree species grow in a variety of climates and have different nutritional requirements (2, 4, 5). Sludge alters the physical, chemical and biological soil properties and should affect tree growth. We do not know precisely how tree species will respond in sludge-amended soils. If sludge is to be considered for improving forest soils, we need to know how sludge affects tree growth and nutrition.

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*Drs. Bledsoe and Zasoski are both faculty members in the College of Forest Resources at the University of Washington. Dr. Caroline Bledsoe, a Research Assistant Professor, received her PhD in Botany from Colorado State University eight years ago. Her interests include forest tree nutrition and mycorrhizal-root physiology. Dr. Robert Zasoski, a University of California at Davis graduate, is an Assistant Professor with interests in soil chemistry and tree nutrition. Numbers in parentheses designate references listed at the end of the article.

Element	West Point	U.S. Average
Nitrogen	2.3%	2.6%
Phosphorus	1.3%	1.8%
Potassium	0.15—0.48%	N.A.*
Calcium	2.4—3.2%	3.7%
Magnesium	0.5—0.7%	N.A.
Sulfur	1.0%	0.65%
Cadmium	40—60ppm	75ppm
Copper	560—980ppm	1600ppm
Lead	1000—1400ppm	2700ppm
Zinc	1900—3200ppm	4200ppm

*N.A. indicates data not available.

Table 1. Composition of Municipal Sewage Sludge from METRO's plant at West Point and from an average value from 33 pretreatment plants in the U.S. (6).

Project description

The research plots are located at the Washington Park Arboretum in a 30 × 50 foot area behind the Arboretum offices. Nursery beds 110 cm × 1200 cm (3.6′ × 39′) and 38 cm (15′′) deep were constructed and divided into thirty 110 cm × 40 cm compartments (see Figure 1). Six different tree species were planted in five different media. The tree species included: Douglas-fir *(Pseudotsuga menziesii),* Sitka spruce *(Picea sitchensis),* western red cedar *(Thuja plicata),* ponderosa pine *(Pinus ponderosa),* western hemlock *(Tsuga heterophylla),* and poplar (*Populus* spp.). (See Figure 2.)

The media used for growing these seedlings was: soil, fertilized soil, sludge, sludge-soil mixture and composted sludge. The soil was a typical forest subsoil mixed with peat (2:1). In the fertilized soil treatment, liquid fertilizer was added to the soil-peat mix. The fertilizer contained nitrogen, phosphorus and potassium at the rates of 200, 150 and 150 lbs/acre, respectively. Sludge used in all treatments was a 20% solids municipal sludge from the METRO plant at West Point. This sludge had been through primary and secondary treatments and had been "aged" for one year at Pack Forest. During the aging process the sludge dries out and pathogen levels are reduced. Forest soil and sludge were mixed together in a 3:1 ratio (by volume). Sawdust and unaged sludge were mixed 4:1 (by volume) and aged for six months; this comprised the composted sludge treatment.

There are variations in light and temperature in the experimental area. These variations could affect seedling growth and favor one treatment over another. This problem was avoided by repeating each treatment four times. To avoid human bias, treatments and species were randomly assigned within each replication (see Figure 3). In each treatment, 30 seedlings of each species were planted on a 10 × 10 cm spacing. A total of 3600 one-year-old seedlings were planted during the first week of April 1978. Overhead screens were built to shade the seedlings, since western hemlock and western red cedar are particularly sensitive to intense sunlight and grow better when shaded. Several seedlings of each species were reserved and measured to determine initial nutrient content. The nursery beds are weeded and watered to eliminate weed competition and moisture stress.

In October 1978 when height growth has ceased and the trees have set a terminal bud, one-half of the seedlings in each treatment will be harvested. The remaining 15 seedlings will be harvested in October 1979. This procedure will provide both one-year and two-year growth and nutrient composition data.

Harvested seedlings will be measured and weighed to determine growth increases. Roots and needles will be analyzed for nutrient and heavy metal content in the University of Washington forestry laboratories. Growth and nutrient data may suggest ways in which sludge can be more effectively utilized. For example, we may learn whether nutrient imbalances develop in sludge treatments, or if toxic levels of nutrients or heavy metals exist (3).

This Arboretum study is designed to yield precise information on response of forest seedlings to soil and sludge treatments. A second purpose of this study is to present to the public a demonstration of tree growth in sludge and composted sludge. Treatments and species are clearly labeled. Persons standing outside the study area can see differences between species and soil

Fig. 1 Nursery beds at the Arboretum.

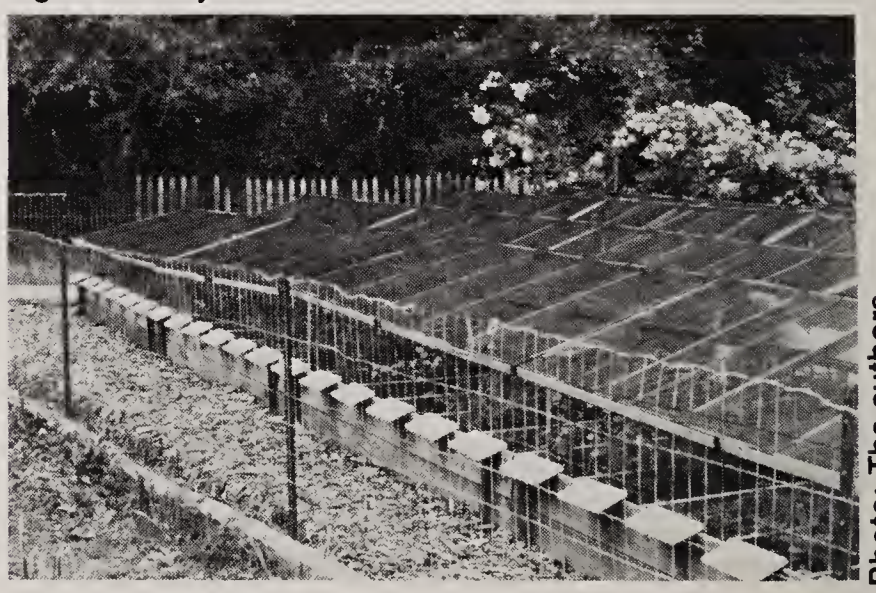

Photo: The authors.

Photo: The authors.

Fig. 2. Forest tree seedlings, from left to right: Douglas-fir, poplar, ponderosa pine, Sitka spruce, western hemlock, western red cedar.

treatment. Final results will be published in a future *Arboretum Bulletin*.

Preliminary results

Visual differences are apparent after five months' growth. All species are growing rapidly in the mixture of soil and sludge and have dark green foliage, which is indicative of more than adequate nitrogen. Lighter green seedlings were observed in the composted sludge treatment, and this suggests a nitrogen insufficiency. The large amount of carbon in sawdust is a food source for many microorganisms. This large microbial population uses much of the available nitrogen, and less soil nitrogen is available to the trees in the compost treatment. Not all tree species have reacted the same in the compost treatment. Douglas-fir has become quite chlorotic, or light green, indicating low foliar nitrogen levels. Ponderosa pine is not as chlorotic, possibly because of a lesser nitrogen requirement.

Seedlings also differ in their tolerance to the aged sludge. Only 15% of the western red cedar seedlings planted in aged sludge have survived. In contrast, the other five species survived very well in the sludge treatment. Growth of all species is poor in the soil treatment. Height growth of Sitka spruce and Douglas-fir after four months is presented in Figure 4. Sitka spruce grew better than Douglas-fir in all treatments, even though both species had essentially the same initial height. In the soil alone Sitka spruce seedlings grew 13 cm in four months. Seedlings grown in the sludge-soil mix grew 30 cm, which is a three-fold height increase. Other treatments also produced height increases, although these increases were not as great as those in the sludge-soil mixture. Seedling color and general appearance correspond well with height growth. These preliminary data for Douglas-fir and Sitka spruce suggest that sludge and composted sludge can be effectively utilized to grow forest tree seedlings.

Final results

In the fall of 1978 and 1979 when all species are harvested, final heights, diameters and weights will be determined. Height and weight of each seedling will be compared to the initial values obtained when the seedlings were outplanted. Seedling size varied among the species. For example, Douglas-fir shoots are approximately twice the weight of the roots. In ponderosa pine seedlings the shoot weight is only slightly greater than the root weight. The interaction of these initial seedling characteristics and treatment effects will be evaluated. Nitrogen, phosphorus, potassium, calcium, magnesium and heavy metal content in roots and shoots will be determined. Growth and nutrient composition data collected for all six species can provide valuable information on the management and growth requirements of sludge-grown trees.

Fig. 3. Experimental design indicating the four replications and the randomly assigned treatments and tree species. The following symbols are used: So = Soil; S+F = Soil + Fertilizer; Sl = Sludge; S+S = Soil + Sludge; CS = Composited Sludge

	REP 1	REP 2		REP 3	REP 4	
S+S	Hemlock Doug-fir Spruce Poplar Pine Cedar	Hemlock Poplar Pine Cedar Spruce Doug-fir	S+S CS	Doug-fir Hemlock Poplar Pine Spruce Cedar	Spruce Poplar Cedar Hemlock Doug-fir Pine	S+F
So	Doug-fir Pine Cedar Spruce Hemlock Poplar	Poplar Cedar Pine Doug-fir Hemlock Spruce	So S+F	Poplar Pine Spruce Doug-fir Hemlock Cedar	Doug-fir Poplar Pine Cedar Spruce Hemlock	CS
CS	Pine Doug-fir Cedar Poplar Hemlock Spruce	Pine Cedar Poplar Spruce Hemlock Doug-fir	CS Sl	Pine Doug-fir Cedar Poplar Hemlock Spruce	Doug-fir Pine Poplar Cedar Spruce Hemlock	Sl
Sl	Hemlock Poplar Spruce Pine Doug-fir Cedar	Pine Hemlock Poplar Cedar Doug-fir Spruce	S+F S+S	Cedar Pine Poplar Hemlock Doug-fir Spruce	Poplar Doug-fir Hemlock Spruce Pine Cedar	S+S
S+F	Cedar Hemlock Pine Doug-fir Spruce Poplar	Hemlock Spruce Poplar Doug-fir Pine Cedar	Sl So	Doug-fir Cedar Poplar Spruce Pine Hemlock	Spruce Doug-fir Poplar Pine Cedar Hemlock	So

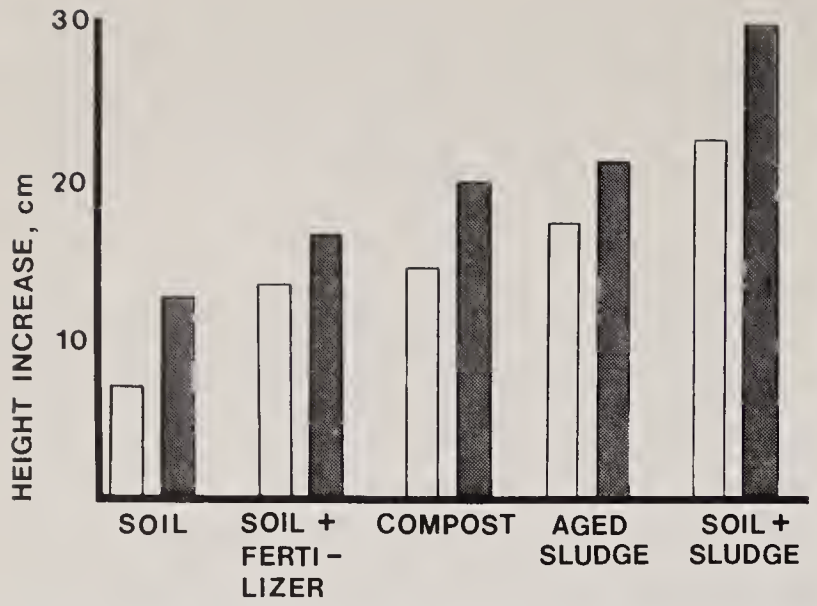

Fig. 4. Effects of soil and sludge treatments on height increase after four months' growth. Values are averages of 10 seedlings per treatment. Open bars = Douglas-fir. Shaded bars = Sitka spruce.

Summary

Municipal waste (sludge) has the potential for enhancing the growth of Pacific Northwest forest species. Sludge has a high nutrient content and favorably modifies soil physical properties. Growth responses of Northwest coniferous species to sludge-soil mixes are not known. This two-year study is designed to examine the responses of five different conifers and one hardwood species to sludge-soil treatments. Different responses of each species to sludge and soil treatments are already apparent. Preliminary data suggest that sludge can significantly increase tree-seedling growth. These detailed studies will provide data on tree-seedling response to municipal waste. Decisions about recycling of municipal waste require information which studies like this can provide. The experimental plots can be seen behind the administrative offices at the Washington Park Arboretum.

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Who is Sigurd Olsen?

Once again we are fortunate to be able to enhance an important article with photographs by Sigurd Olsen. Dr. R.F. Stettler's essay, "On Plants and Their Essence," contains several of these technically superb works of art.

Who is this man the *Bulletin* has come to rely upon for illustrations?* Born in Copenhagen, he is presently a freelance biological photographer working out of his Seattle studio. Before 1972 he held various research positions on the faculty and staff of the University of Washington. His more than 40 articles, largely on aquatic ecology, date back to 1936. He received the Gold Medal from the University of Copenhagen in 1939 for his paper on Danish Charophyta. About 10 years ago he was elected to the honorary society Sigma Xi. We at the *U.W. Arboretum Bulletin* cannot honor him in such formal ways, but we would like to add a note of appreciation to his already formidable list of accomplishments.

*Articles in the *Bulletin* which contain Mr. Olsen's photographs are: 1) Belt, S.C. 1978. Seeds and seed products; their ornamental uses. 41(2):17-21. 2) Denton, M.F. 1978. Sexual reproduction in flowering plants. 41(1):18-25. 3) Meeuse, B.J.D. 1973-4. Seeds and fruits and their dispersal strategies. 36(3):11-17; 37(1)2-6. 4) Meeuse, B.J.D. 1976. Butterflies in the Arboretum, Part II. 39(3):16-23. 5) Smith, C.C. 1978. How trees defend their seeds. 41(2):22-27.

On Plants and Their Essence

*REINHARD F. STETTLER**

We look at them every day, at home, in the garden, on our drive to work, in the office, in the park — yet we don't see them. We accept them as an integral, in fact essential, part of our environment. We plant them, we take care of them, we argue for them in urban planning. We know their names, often even their Latin binomials; we know their soil and light requirements; we know how to propagate them; we are familiar with their life cycle, their anatomy, their morphology. We have learned to distinguish between xerophytes and mesophytes, gametophytes and sporophytes, obligate selfers and apomicts, r-strategists and k-strategists.

Yet, if we were asked what is the *essence* of a plant, what it is that a plant transmits to us, we might find our pat answers inadequate. We would detect that our scientific terminology, our accurate and descriptive terms, catch a fragment only of the essential. Some might even argue that a comparatively naive observer will perceive a plant in a more holistic way, unencumbered by minutiae. Knowledge, although conducive to understanding, may also impede it.

Have you ever experienced the curious detachment one may sense when cruising in an airliner at 30,000 feet with some broken clouds below? It was on a recent flight across the northern tundra that I was struck by the timeless pattern of a meandering river way below in the gray-green landscape.

Meander: The sequence of loop and counter-loop a water course will assume on a mildly inclined plane, result of hydrodynamic forces interacting with an erodible substrate, combining the deterministic with the probabilistic. Meander: at this distance a mere ornament on an abstract earth and reminiscent of countless friezes in Hellenic architecture. I could not help but wonder how man had acquired this pattern in his artistic repertoire. Was it a mere copying process, the satisfaction of capturing recurrent form in a lasting medium? Was it a matter of heightened receptivity for the natural, a creative resonance evoked by what seemed to be the *essence* of a river? Or was the similarity a mere coincidence without inherent connection?

It is with this detached curiosity of an air traveler that we will undertake this short reflective excursion into the kingdom of plants. It will originate with the common observation that the natural world, and even more so the organismic world, holds a special fascination for us; and it will explore what it is about plants that reaches out to us differently from what we experience in the presence of animals. We shall be primarily concerned with those plants and animals we commonly perceive around us and at a scale and resolution compatible with our sensory organs. But this is not to rank the eye over the mind. Rather it is to elicit that mental activity "which ceaselessly weaves connexions between the planes of intangible 'essence' and tangible 'existence' " (Arber 1964).

Permanence

The sessile nature of plants conveys a sense of permanence. This is no small matter in a world of change where reference points seem to slip away, where generations appear in haste, where the crosscurrents of cultural evolution create confusing arrays of incongruous value systems, where choices far exceed necessity. Plants are rooted. They may sway in the wind, send out runners, disperse their seeds — but they stay.

The organismal permanence of a tree and, *a fortiori,* the aggregate permanence of a forest have always held a special fascination for man. There is something powerful emanating from a persistent living form which goes beyond the static permanence of a rock or a mountain. After all, life is finite — yet, in these organisms it seems to assume a timeless dimension. Is it therefore surprising that a creature as domesticated as the urban dweller will go to the barricades to save a tree? Or is it any wonder that the sight of a clearcut hillside will violate most people's intuitive notion, including that of many foresters, of how a forest should be husbanded?

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*Dr. Stettler, Professor in the U. of W. College of Forest Resources, is a member of our editorial board. *Bulletin* readers will remember his article, "The Hazards of Genetic Uniformity in Plants" (Vol. 36, No. 1, 1973).

There is more to permanence than being there. It means to be irrevocably anchored in a small segment of the environmental mosaic. As Willa Cather expressed it: "I like trees, because they seem more resigned to the way they have to live than other things do." While more manifest in trees, it is the condition of all plants.

Permanence means not only to submit to the constraints of the locale but also to endure the changes of time. The pulse of diurnal oscillations, the rhythm of seasonal change, and such cyclical if less predictable events as storms, floods, et cetera, are as palpable in plants as in any organism and often leave a permanent record. If the notion of a silent spring was alarming to most environmentally concerned people, what would be a March without swelling buds or an October with permanent greenery! Is it not the presence throughout winter of the dormant vegetation that conveys a sense of continuity in the face of a hostile environment? We know there is life in these brown twigs, protected in the inner reaches, and it will burst to the surface again when the days get longer. There is a mystical power of cosmic proportion in the predictable cycles of seasonal change and it is the plants that seem to transmit it in a form and dimension most compatible with our perception. Until recently we could even tell the month of the year by the fruit or vegetables we would find on the grocery shelf. The advent of the greenhouse and modern breeding methods have largely freed us from this constraint — but at the same time we have lost another set of gentle stimuli that used to nudge us along the time path. I am probably old-fashioned but to me there is something utterly incongruous about a sauerkraut meal being topped by fresh strawberries!

If plants' quiet persistence generates a feeling of permanence, this may have much to do with our ability to observe them. Plants invite observation. They stay there, hold still, and are patient with our sensory frailties. We don't feel pressed to catch a fleeting glance of them. And while they may provide no more than the comfortable green for what our unfocused eyes perceive as "the environment," they also hold startling discoveries for us when we are up to it. Linnaeus' *Systema Naturae* was conceived in relation to plants and then extended to the animal kingdom. Although Mendel dealt with both, it was the flowers, not the bees, that revealed the laws of heredity in the monastery at Brno. At the same time, we may well say that it was the preoccupation with describing plant communities that hindered progress in ecology during the first half of this century. Anybody who has even casually looked at the intricate structure of some natural vegetation will appreciate the temptation to become engrossed in static nomenclature.

Movement

If permanence is conveyed by the persistent occupation of space, immobility would be anathema to our image of a plant. Movement forms an integral part of it. The swaying of a birch tree, the undulate patterns of light and dark migrating over a wheat field, are powerful indicators of the flexible substance of stems and leaves. There is something remarkably rhythmic about the movement of plants. Have you ever tried to analyze it? All that is needed is to stroll to the nearest park on a windy day and place yourself at some distance from a bigleaf maple. You will see ripples moving through the crown, usually beginning with a gentle change in orientation of a group of leaves, followed by their displacement as a group relative to other leaves on neighboring branches; this in turn is followed by a counter-

movement due to the resistance of the branch while neighboring branches are now caught in the original movement. Each motion is transmitted, dissipated, muted and countered, each moving part describing an elliptical path of varying amplitude, all brought into relational harmony by the hierarchy of connecting links: petioles, twigs, branches, stems. What is eminently restful about plant movement is its cyclical nature. Essentially, each displaced part returns to its original position thus restoring the initial state and conveying a sense of equilibrium. Time and again the circle is closed.

There are more subtle movements than those generated by a buffeting wind. Petals open and close in diurnal rhythm, flower heads follow the sun, leaves orient themselves toward the light — yet none of these phenomena is actually perceived other than by deductive reasoning. We all have marveled at the dramatic amplification of these motions by time-lapse cinematography. However, the resulting image of a plant with flapping leaves and rotating tendrils cannot fail but strike us as an absurd caricature. Once more we realize how much we are in tune with time's pace. In a similar way every one of us has been fascinated by the characteristic leaf response of a mimosa. It is the fascination by the unusual because, after all, plants are not normally so skittish.

Plant movement is contrapuntal to permanence. It enhances the organismal effect and accentuates our impression of a living form in dynamic equilibrium.

Growth

The sessile nature of plants seems to have predisposed them for a pattern of growth distinct from that of motile animals. We commonly call it an "open growth" system referring to the remarkable lack of constraints determining the ultimate fate of any group of initial cells. It may be viewed as an opportunistic response system involving multiple apices each having the potential to assume an active role in growth, and being regulated in relation to external signals. This pattern is particularly conspicuous in perennials whose ultimate shape reflects in large measure the unique blend of environmental determinants experienced. Is there a more expressive testimony for wind than the one-sided crown of a Sitka spruce on a coastal bluff?

The morphogenetic plasticity of plant cells manifests itself even more when they are isolated in a test tube. Entire plants can be regenerated from a single leaf cell under repeatable conditions in synthetic media. You may even "re-program" pollen of tobacco to undergo embryogeny and develop into a normal plant albeit with a single set of chromosomes only. By contrast, animal cells tend to lose their totipotency, i.e., the ability to grow into a complete organism, after only a few divisions of the fertilized egg. This is not entirely surprising since in a mobile organism, size, shape, and proportion, as well as the number of particular organs such as legs or wings, are of crucial importance for coordination and balance in movement.

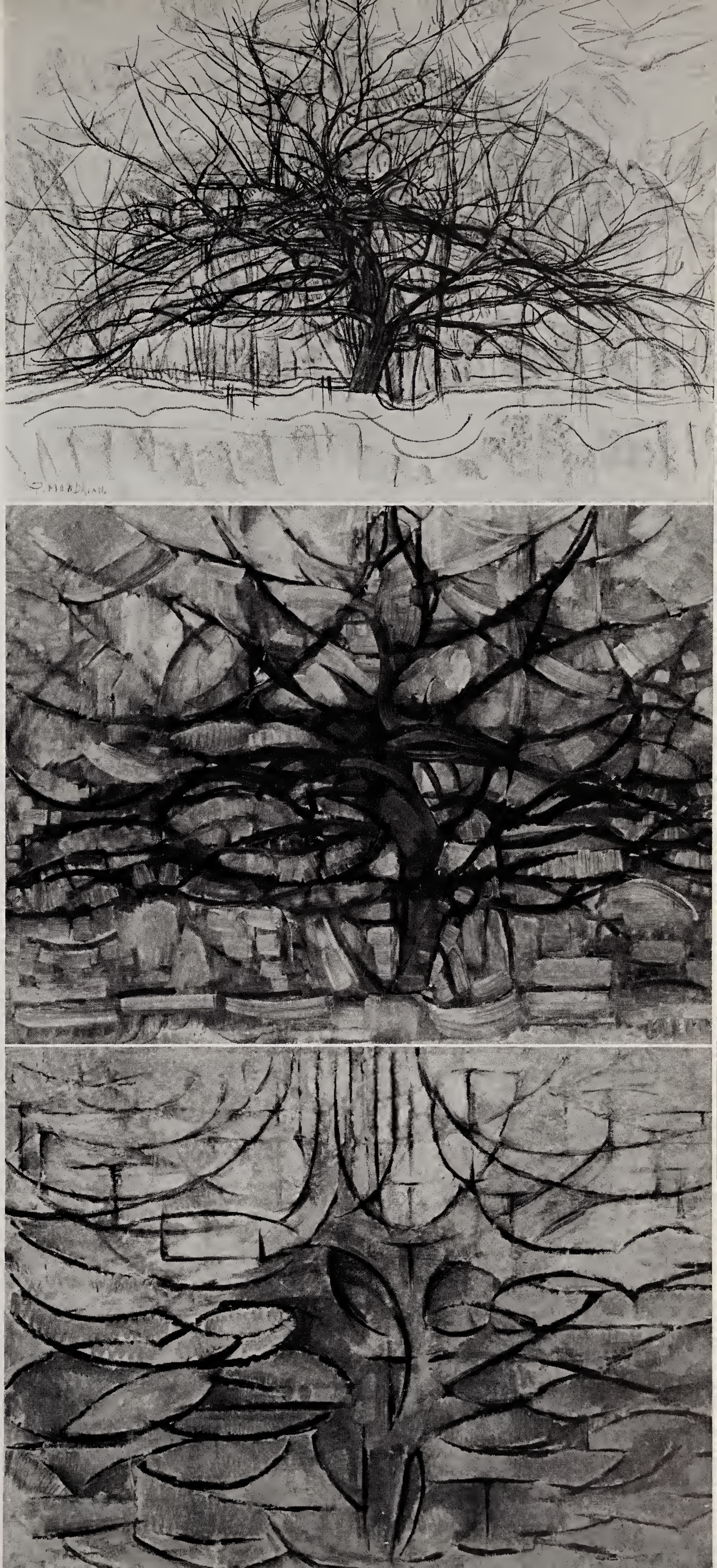
If indeterminate growth explains much of the asymmetry and unpredictability of plant form, determinate growth accounts for the consistency of such conspicuous organs as flowers and leaves. Indeed, would there be a flower industry, were it not for the predictable element in plant growth? Again, it is the passive presence of plants that has invited so many curious minds to unravel the mathematical rules underlying plant design, from the arrangement of leaves along a stem to the geometry of florets in a sunflower to the branching angles of trees (e.g., Stevens 1974).

Let me point to another aspect of plant form that is associated with the open system of growth. I will call it the "population effect," referring to the presence in an individual plant of many repetitious elements that display variation on a certain theme. Even the most modest of annuals will have a number of leaves, each resembling the others, all conforming to a characteristic model, but no two among them exactly alike. Often there is increasing complexity as the plant grows, yet not sufficient to obscure the communality. Physiological gradients, light, temperature, insects may impose secondary and tertiary themes but rarely disturb the basic formula. Unified by their attachment to a common stem, yet individual in their position and orientation, leaves are proximate enough to invite comparison. There is just enough

ILLUSTRATIONS

All plant photographs in this article are by Sigurd Olsen.

The works by Piet Mondrian reproduced on page 21 are in the collection of the Haags Gemeentemuseum in The Hague. They represent a development toward abstraction in the artist's perception of a tree. From top to bottom they are: "Boom II, 1912," "De Grijze Boom," and "Bloeiende Appleboom."



variation to convey a sense of the natural but not enough to generate confusion. If sufficiently apparent in annuals, this phenomenon assumes an additional dimension in perennials and—if my dendrophily be forgiven—reaches its culmination in trees. What is so remarkable about the repetitive patterns of leaves, twigs, branches, and limbs of an old oak is how differently they strike us than those of perhaps an elm. Many of us would be hard-pressed to identify the discriminating features but few of us would mistake one tree for the other.

The image of a tree crown is quite appropriate for our consideration of another aspect of plant growth, namely the use of space. If, as has been recently suggested, the human organism is merely the DNA's way of making another generation of DNA (Dawkins 1976), it may not be as frivolous to view a tree as a stratagem to position a maximum of chlorophyll into the path of light rays thereby facilitating its function. Petioles, twigs, branches, limbs, trunk and roots thus serve as a framework to best use the available space and to provide for the translocation of chemicals involved in the process. The overall geometry reflects parsimony and, as several studies have shown, involves many design features that approximate maximum efficiency (e.g., Horn 1971). But regardless of whether or not we are familiar with principles of photochemistry and hydrodynamics we seem to appreciate quite intuitively the even partitioning of space by a tree. While there may be some asymmetry as a result of unequal light distribution there is little crowding of twigs and rarely a major gap.

And if we look at neighboring trees in a grove, or examine the various strata of the forest canopy we note again a remarkable complementarity, the blending-in of contours, the merging of peripheries, the mutual accommodation. No herd of wildebeests, no flock of starlings conveys this sense of harmony — misleading as it may be since a forest is just as much an arena for competitive interaction as the turf of the savanna. It must be the perpetual record of relational growth that catches our eye in the greenery.

Plurality

Do plants have a soul? I suspect we never will know, but judging by the recurrent preoccupation with this quandary there will always be some among us who are anxious to grant this condition to their green friends. Yet I submit that if ever sufficient evidence become available to confirm this belief, it would shatter a long-standing, harmonious relationship, because it would rob plants of one of their most valued attributes, their anonymity.

Several components contribute to this impression of a lack of identity. Almost all plants are green. In part because of this, in part because of the somewhat unpredictable shape and size of plants, the boundary of an individual organism cannot be as clearly perceived as it can be in animals. The lack of mobility maintains aggregate groupings and does not resolve them into component members.

Above all, plants do not manifest an intent. There is an aura of serene indifference about them. Even if we get stuck by a devil's club or develop a rash from poison oak we do not suspect the plant of malicious intent, rather we feel embarrassed about our clumsiness. How differently we react to a mosquito bite! Not only do we view it as an act of aggression but as one involving premeditation and being directed *ad personam*. In the same vein we interpret the limp leaves of a dahlia as a sign of physiological stress rather than a clever ploy to get the gardener's attention. The striking plumage of a male peacock and the flashy red of an Indian paintbrush both serve to assure reproductive success. But one seems to be the expression of the individual, the other of the species.

There is a silent plural in each plant, a generic image, the cloth of its order, and it seems to negate individual expression. The statement by a California politician, "If you've seen one redwood, you've seen them all," will probably never be quoted in a taxonomic monograph on *Sequoia sempervirens*. A testimony of value judgment rather than of perceptive acuity, it does appeal to the common notion that indeed it would be hard to tell the difference between one redwood tree and another or, for that matter, between any other members of the same species. The now historic Linnaean concept of a species prototype from which individuals deviate merely because of incidental imperfections, seems to have some intuitive appeal — but eminently more so in the ordering of plants than of animals. Nobody would ever suggest that one cow stands for all the others — yet genetic studies show clearly that members of a herd are likely to have many more genes in

common than do trees in an average Douglas-fir stand of comparable numbers. But we *know* that no two cows are alike. It is the *anima* that seems to bestow uniqueness.

Finally, there is again that strange continuum between unity and diversity which in plants blurs the role of the individual — at least to the observer. I have earlier labeled it the "population effect," referring to the reptitious but variable elements in a single individual plant such as leaves, shoots, flowers and fruits. Far from generating merely a pseudoplural this phenomonen gets carried to considerable extremes in the many plants that propagate themselves asexually by surface stolons and runners, by offset buds on corms and bulbs, or by underground rhizomes and tubers. Thus, so far as genetic identity is concerned a stand of aspen or a thicket of blackberries involving hundreds of stems may in fact be one individual. On the other hand, to ignore the cumulative aspects of the aggregate and to equate it with a singular unit is to ignore the laws of mass and numbers. Indeed, fascinating insights have been gained into strategies of resource allocation, response to stress, developmental plasticity and related phenomena by studying plants as populations of parts or, in other words, as highly flexible aggregates of modular units (Harper 1977).

It seems then that in many of our considerations the plant does not impress us as an individual. Unit, aggregate and population are inextricably intertwined and in the process of separating them something gets lost. To be sure, there is that picturesque Coulter pine in front of our Forestry building, and there is that columbine in my backyard we had collected on Granite Mountain— but they are *plants,* above all. They have that quiet generic property that blends with the background, shares in a common green, and does not ask favors.

Theme and Variation

> He to whom Nature
> begins to reveal
> her open secret
> will feel an irresistible yearning
> for her most worthy interpreter,
> Art.
>
> *Goethe*

In his *Abstraction and Empathy,* Wilhelm Worringer (1908), the art historian, examines the recurring urge of man to abstract nature in art. A seminal book that had much influence on the attitudes

towards abstract art, it develops a strong argument for the central role plants play therein.

Worringer views the artistic expression as being governed by two polar motives, abstraction and empathy. Whereas the urge to empathy roots in a "happy pantheistic relationship of confidence between man and the phenomena of the external world, the urge to abstraction is the outcome of a great inner unrest inspired in man by the phenomena of the outside world." In this "immense need for tranquility" man seeks to free the external phenomena from their arbitrary context, "purify [them] from [their] dependence upon life," and approximate them to their absolute value. In this endeavor, Worringer proposes, the living or organismic world and in it the world of plants in particular, provides much more powerful stimuli than the physical inorganic world. "The organismic, even in its abstraction, touches us more gently and is more consonant with our sense of being. It is, thus, capable of quietly eliciting our latent impulse to emphathy" (author's translation). Furthermore, he argues "organic *Gesetzmässig-*

keit [order, law, pattern] ... is most purely and perceptibly disclosed to us in the structure of plants." It is for this reason, Worringer suggests, that plant form, in various degrees of abstraction, is such a central theme in artistic expression. The ultimate motive, he feels, is not an urge to imitate the natural "but the need to experience felicitation through the mysterious power of organic form, in which one could enjoy more intensely one's own organism."

The art historian's articulations would find more resonance today, notably outside his discipline. Never before has the question as to how humans relate to plants received more attention than over the past few years. Responsive to a new environmental awareness, sociologists, psychologists, botanists, landscape architects and planners have begun looking more systematically for the underlying forces involved in, and the benefits derived from, people-plant interactions (see the recent article by Charles A. Lewis in this journal). What inspires the artist may well be at the root of other more common phenomena such as the therapeutic effects of gardening or the quieting influence experienced in the presence of plants.

If I were asked to isolate a common denominator for the manifold psychic responses elicited in us by plants, conscious or subconscious, I would search for it in the way plants embody *natural variation,* and in the way this relates to the universal phenomenon of organic variation. Let me explain my argument.

In the living world around us no two organisms are exactly alike. This is not to say that organismal variation is chaotic. After all, we recognize some resemblance among relatives, some coherent variation patterns among groups of species, or what we might call some emergent *themes.* These themes are generated by constraints set upon the free evolution of variation as a result of specific regulatory mechanisms. One such mechanism would be the mating system of an organism, determining the average degree of relatedness among uniting sex cells and, thus, influencing the degree of resemblance among parents and progeny as well as the similarity among offspring. There are other mechanisms such as migration frequency, mutation rate, population size, et cetera, each operating at a specific level of organization (for example, individual, population, species) and each being subject to natural selection. What this means is that each species strikes a unique compromise in the overall regulation of variation, and that the evolutionary success of the formula can only be determined *a posteriori.* And quite remarkably, from all we know, every species in the infinite array of organisms around us seems to abide by this rule.

Thus, while variation is of the essence, it is the theme that reveals the inner workings of nature. And while themes seem to be inherent in all life, and at all levels of organization, they are particularly perceptible in plants for reasons which in closing we may briefly reiterate: their sessile nature invites and rewards observation; their "permanence" conveys a sense of timeless *Gesetzmässigkeit;* their growth system displays variation among the repetitious units in a single individual; and their individual value seems to submit to the plural, thus reinforcing the common theme.

Is this the essence of plants — that they embody theme and variation in a manner which brings us in tune with the organismic world altogether? I am tempted to say so. But the residual uncertainty is sufficient to keep me musing on another northern flight.

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Neill Hall— The Fern Man

We in Seattle can be proud of our "fern man." Chairman of the spore exchange of the American Fern Society for 17 years, Neill Hall has accumulated spore and encouraged exchange until he is now known by fern specialists internationally. Ruth Vorobik, a member of our editorial board, conducted the following interview with him on February 17, 1977. He began:

Interest has built to where I have contacts all over the world. Here is two years of correspondence [a six-inch thick file], each letter a request for spore and/or information. In response to these requests I usually make a mailing containing from 150 to 200 packages of spore with a covering letter answering questions, and perhaps asking some of my own. I have travelled since retiring, and where spore is ripe, I collected and am perhaps responsible for collecting some spore of 25 percent of the 800 species and varieties represented here. Much of the spore in these envelopes is from remote areas such as small islands off New Zealand where few people are permitted, the Isle of Reunion (off Madagascar) where a French botanist collects for us, [and from] another botanist in the back country of Africa. A professor who used to be at the National Botanical Garden at Lucknow, India has sent spore from that area and now sends from around the University of Calcutta. From Japan, the University of Kyoto recently sent 200 species, and we get spore lists from there and from the University of Tokyo and Tohoku University at Sendai.

Much of this material is scientifically identified, many times with background information — place, date and history. Some give specific location — highway miles from nearest town, elevation above sea level and exposure — which information gives additional indication of hardiness. An Oregon park department naturalist, who spends vacations in Mexico, sent herbarium material to the New York Botanical Garden for identification and then sent the identified spore to me. From him we have many very beautiful aspleniums and rare tropical ferns. At times unpublished monographs are sent, and they add greatly to the fund of knowledge I have available. A commercial grower in Australia who has done collecting in the back country sent spore of two rare dwarf tree ferns whose ultimate height is six feet —rare in Australia, and yet the quantity of spore sent, if grown, could give us a forest.

When I first knew you it was as a member of the American Begonia Society. What started your interest in ferns?

It started from old books. The American Rock Garden Society used to have a rare book night that was held in the living room of Dr. and Mrs. Frye. Members would bring out many of these old books, but I thought I could never afford any. It was about 10 years later that I finally wrote to a bookseller in England and asked him if he had any old fern books. He wrote back and said he had an eight-volume set for $25. Since the price also included shipping costs I felt I could afford the purchase. How fortunate for me. This set, *Ferns, British and Exotic* by Edward Joseph Lowe, published in the 1850's, is an early example of color lithography. A book purchased soon after was *Century of Ferns* by Hooker, published in 1854. It contains black and white lithographs which are hand-tipped in color. These old books and others purchased as I was able, plus membership in the American Fern Society, got me so interested in the different and exotic ferns that I took advantage of the society's spore exchange and began growing ferns from spores.

In 1961 I retired and with Mrs. Hall took a trip around the United States. Along the way I met many of my fellow Fern Society members and visited some of the outstanding collections of ferns in our country. Shortly after returning home, the president of the society asked if I was interested in heading the Spore Exchange, and here it has been ever since. We have spore of about 800 species and varieties, and after a trip to the University of California at Berkeley, I expect to add another 100 species. I have stimulated interest by placing notices in the Journal of the Society. The spore list now goes to all members, many of whom collect and contribute. The

Pteridological Society of Great Britain lists my name as a source, and this information does get around.

Is collecting spore difficult?

It takes time to get to know when the spore is ready to collect. The receptacles take on a dark color. If they are dull and tan-colored the spore generally has been dispersed. Spore ripens at different times of the year. Among the first to ripen here are the osmundas. They ripen in the spring — that's green spore — with a very short viability period usually lasting only a few days. It must be refrigerated. In collecting one must watch daily. On a day when the sun comes out and it is relatively warm, if the frond is touched and green smoke appears, I put papers around the frond and tap it, then spill the spores into a legal-size envelope. I include a piece of the frond and record name, date, place of collection, et cetera, on the envelope. A small piece of frond sent with the spore gives an indication of the appearance of the mature plant to a grower not familiar with the species. In many of the hardy species the spore ripens and disperses quickly on a warm day. The color can be anything from white to yellow, green, brown and black with viability varying from a few days to many years.

Neill, the spore exchange has made a significant demand on your time. If you had it to do over again, would you accept chairmanship?

Yes! Operating the spore exchange for the American Fern Society has given me the privilege of knowing fern people in many parts of the world. Learning about ferns is a continuing educational process. Collecting keeps you young, though the hills seem steeper. And now we are to have a chapter of the American Fern Society here.

Note: A new fern study group meets in members' homes, and has gone on numerous field trips. The group is presently engaged in creating a herbarium of ferns for the Arboretum; Mr. Hall already has over 100 pressed specimens.

Special Programs

The Northwest Ornamental Horticultural Society has planned for 1979 a series of four public lectures around the theme SHAPING YOUR GARDENS. These will be held on Thursdays at the Museum of History and Industry. A half-hour exhibit will precede each lecture. They are as follows:

"Creativity: Three Views." Participants: Patricia Gutter, Assistant Professor of Landscape Architecture, University of Washington; Donald I. Foster and William Overholt, collectors. February 8 at 11 a.m.

"Pruning: How To and How Not To." Chico Narro, formerly Senior Nurseryman, U.W. Arboretum. March 8 at 11 a.m.

"Topiary: A Fascinating Garden Specialty." Sally Reath, Philadelphia, Pennsylvania, internationally known horticulturist and lecturer, topiary expert. April 19 at 8 p.m.

"Our Native Plants: Priceless Treasures." Roy L. Taylor, Director, University of British Columbia's Botanical Garden. October 11 at 11 a.m.

The Pacific Northwest Heather Society was formed in August 1978 for the purposes of improving communication between heather growers and making information about heathers available to the public. A demonstration garden has been planned at the Arboretum featuring the most desirable, available heather varieties. The president is Ken Wilson, Supervisor of Operations, U.B.C. Botanical Garden.

Membership is open to all at $3.00 per year. A group membership will be maintained in The Heather Society, centered in Britain. Information may be obtained from the corresponding secretary, Dorothy Metheny, 2810 46th Avenue, W., Seattle, 98199 (206) 284-9092.

The Pacific Science Center is sponsoring a lecture series by Glen Hunt on landscape design on six consecutive Thursday evenings — February 8 thru March 15, from 7:30 to 9:30. This will include a field tour of contemporary and traditional gardens in the Seattle area on Sunday, March 11 from 1:30 to 3:30, a small group experience for adults. For information call Jan McLachlan at the Pacific Science Center, 624-8140.

See page nine for information about an important symposium to be held on January 26 on "The Politics of Trees."

Another Honor for Brian Mulligan

*ARTHUR R. KRUCKEBERG**

Brian Mulligan's distinguished career in horticulture continues unabated today in his "retirement," as it did when he was Director of the University of Washington Arboretum in Seattle. Brian is always the final authority on the identity of even the most obscure and uncommon plant, both in the wild and in the garden. Since his retirement in 1972, he has made notable contributions to the study and appreciation of cultivated plants. The locator catalog on the woody plants of the University of Washington Arboretum is a case in point. This work, published in 1977 (*Woody Plants in the University of Washington Arboretum)* is a careful, painstaking, and useful compilation of the woody plant treasure of that collection.

Brian is involved in many other plant-oriented activities these days. He still gives expert service to the Arboretum, is editor of the Newsletter (*Douglasia*) of the Washington Native Plant Society and gives of his time and expert knowledge to many different horticultural ventures. But, of course, he is known to the rock garden clan all over the world for his many contributions to furthering the knowledge and pleasure of growing alpines and other rock garden subjects. Many have read his informative articles and enjoyed his superb black-and-white photos in the journals of rock gardening—our own Bulletin and the British journals. He has served on the board of directors and as vice-president of the ARGS, and was chairman of the Northwest Unit in 1963.

In the field, at rock garden plant sales and shows and at every meeting of the Northwest Chapter; [sic] one can count on Brian (and his charming, knowledgeable wife, Margaret) to add with their knowledge and plant-growing skill to produce the unusual for all to enjoy. Plants in all their variety are a Mulligan passion that he shares with others and thereby enriches all our lives.

The Mulligan history starts in 1907, when Brian O. Mulligan was born, near Belfast, Northern Ireland. By 1927 he had graduated from the Royal Horticultural Society's school of horticulture at Wisley, Surrey, England. From then on, he has pursued ornamental horticulture with zeal and skill to this moment. In 1946 he assumed responsibility for the new arboretum in Seattle, becoming the director of the University of Washington Arboretum the next year. He retired in 1972, with the title of Director Emeritus — and a very active and useful Emeritus he continues to be!

Brian's achievements as a plantsman have been acknowledged in many ways: through responsible affiliations with horticultural organizations and by awards given him. He was appointed Vice President of the Royal Horticultural Society in 1974; he was a founding member of the Washington Native Plant Society, and is currently serving as a board member and editor for that Society. Brian's work in horticulture has been recognized both at home and abroad. In 1963 he was given a Gold Medal by the Massachusetts Horticultural Society. In 1974 he was presented with the Bronze Medal from the Seattle Garden Club for bringing International Recognition to the University of Washington Arboretum. In 1971 he was given the prestigious Veitch Memorial Gold Medal by the Royal Horticultural Society for service to horticulture. In 1971 he was given the Bronze Medal by the Seattle Chapter of the American Rhododendron Society — the highest award given by a chapter.

The ARGS Award of Merit to Brian O. Mulligan thus honors and recognizes with gratitude the distinguished services to horticulture in general and to rock garden plantsmanship in particular that he has so generously given over the years.

*Dr. Kruckeberg was asked by the American Rock Garden Society to write this tribute to Brian Mulligan when an Award of Merit was presented to him at their 1978 annual meeting in Stamford, Connecticut. It is reprinted, with their kind permission, from the *Bulletin of the American Rock Garden Society,* Vol. 36, No. 3 (Summer 1978).

Growth of a Collector's Garden—

Part II

*BRIAN O. MULLIGAN**

Margaret Mulligan with the tree of *Cornus kousa* flowering in their garden in July 1974. Photo: Brian O. Mulligan.

(Continued from the preceding issue.)

Southeast of the patio, with the pumphouse and greenhouse beyond, is a small triangular bed some ten years old (M). Its chief feature is a vigorous young Serbian spruce *(Picea omorika),* planted in 1968 and now 18 feet tall, which first produced cones in 1977. Beneath it is a plant of our native evergreen huckleberry *(Vaccinium ovatum)* selected for the mahogany-red coloring of its young shoots in spring; we are propagating this color form. At ground level beneath it is a single plant of the small shrubby *Spiraea* named 'Normanii' which traces back to the garden of the late Mrs. T.C. Frye in Seattle, and is no doubt a form of the variable *S. japonica.* Although it has not flowered, we value it for the brilliant red fall color, which lasts for about a month in October and November. If propagated in quantity it would be an excellent ground cover, since it only reaches about a foot in height. It was also distributed by Carl Starker of Jenning's Lodge, Oregon.

Most of the rest of this bed is filled with various kinds of *Calluna* and *Erica,* giving color and interest at different seasons, together with several plants of *Rhododendron hippophaeoides* which agrees well with them both in habit and foliage. The latter species gives us lavender-blue flowers in April. At the east end of this bed is a young plant of *Fothergilla major,* grown both for its tufts of white flowers and for its orange to red fall leaf color.

The greenhouse (19 by 10 feet) was constructed in 1972-73 following my retirement from the Arboretum, with funds most kindly given me at that time by the Arboretum Foundation (N). It is used for two basic purposes: (1) to propagate plants useful for the annual sales of the Foundation, Northwest Ornamental Horticultural Society, Northwest Chapter of the American Rock Garden Society, various Units of the Arboretum Foundation, etc.; (2) to house plants not sufficiently hardy to withstand our average winters, such as succulent plants, tender species of ferns and rhododendrons, and pelargoniums. For propagation purposes it was fitted with a heated bench and overhead lights, and with these accessories we have been able to produce a large variety of young plants.

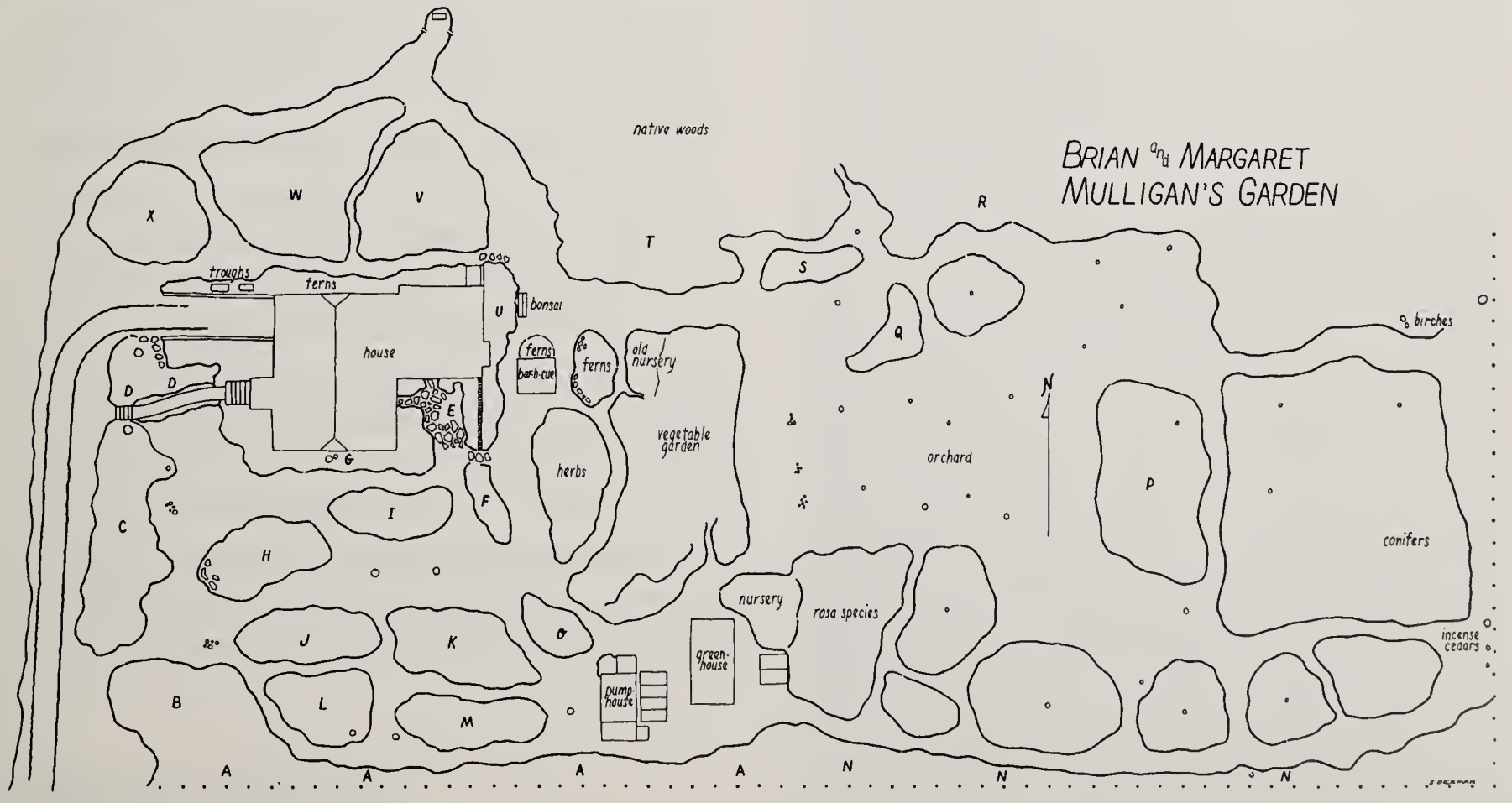
A set of four 6- by 3-foot frames was built at the same time on the east side of the pumphouse to contain young plants growing on in pots or

flats; these are plunged in a mixture of soil, sand and Perlite to reduce water loss by evaporation. On the south side of the pumphouse are two smaller frames containing bulbs, mostly *Narcissus* species, *Crocus* and *Cyclamen* which need a summer baking. To the east of the greenhouse are two more 6- by 3-foot frames filled with soil where rooted cuttings can be planted directly and grown on until they are large enough to be planted out. These are chiefly used for ericaceous plants which do not like being contained in pots. Adjacent to them is a small nursery area for growing on young trees and shrubs to planting size in the garden or elsewhere. Protecting all these to the east is a group of old plants of several species of *Rosa,* now eight to ten feet in height, flowering profusely in June each year and fruiting equally well in September and October. The pink form of *Rosa moyesii* and a large specimen of *R. setipoda* or a hybrid thereof are the best of these.

The upper half of the south lot was first an orchard begun by the original owners in the 1920's with single trees of a 'Gravenstein' apple, a 'Seckle' pear, an 'Italian Prune,' a cherry and a peach. The first four still survive, although the cherry is dying rapidly. Both the apple and pear fruited well in 1977, no doubt encouraged and helped by an annual dressing of complete fertilizer which we give to most of the fruit trees in October or November so that the winter rains can wash it down through the grass. The second owners added five more kinds of apples in the 1940's, including the invaluable 'King' which gives us some fruit almost every year, and a 'Golden Delicious' which is not so successful since it is very prone to apple scab disease in this climate. As already mentioned, in the early 1950's we added more varieties imported from England, including 'Fortune,' 'Cox's Orange Pippin' and 'Winston.' This selection gives us apples from September to April.

Three incense cedars *(Calocedrus decurrens)* from southwest Oregon were planted along the east boundary fence in the mid-1950's; these have flourished and are now robust young trees up to 35 feet in height with 12-inch trunks. Two other conifers doing well in this area are a specimen of our native grand fir *(Abies grandis)*, from the Cascade mountains, and the Santa Lucia fir native to southern California, *Abies bracteata,* now over 20 feet and growing rapidly. A short hedge of *viburnum lantana* also serves as a partial screen along the fence. These were raised from seeds collected in Surrey, England about 25 years ago. Several birches here also provide contrast especially during the winter months with their white trunks and fine branch pattern, having as background a very large western red cedar 75 to 80 feet tall.

In 1975 we dug a new border (P) to provide space for various young trees and shrubs that had been growing in the nursery. This was rather more than 30 feet long and 6 to 7 feet wide, tapering at each end. In the center we placed *Arbutus unedo* 'Rubra,' at the south end a healthy specimen of *Sorbus latifolia* of the *Aria* group with undivided glossy green leaves, and at the north end a seedling plant of the Atlas mountains broom, *Cytisus battandieri,* obtained from the nursery of Mareen Kruckeberg. The latter, which resembles a laburnum more than any other species of broom, flow-



ered in June 1978. In the rear is a bush of the charming *Rosa elegantula (R. farreri* var. *persetosa),* native of China; it has very small leaves and pink flowers in May less than an inch across. We used such ground covers as *Daboecia cantabrica,* the silver-leaved *Salix repens* var. *nitida (argentea),* a collected form of *Juniperus horizontalis,* several 10-year old seedlings of *Viburnum davidii,* which have not yet flowered, and a group of our native *Penstemon fruticosus* var. *scouleri.*

The following year we widened the border in the front by about 2½ feet. There we planted some seedlings of *Berberis calliantha,* most of which are hybrids, unfortunately, and several *Rosa* species or old hybrids raised from cuttings, including *R. andersonii* with its rich pink flowers in June, the double form of *R. pomifera,* and the more or less trailing *R.* × *richardii (R. sancta)* with its succession of pale pink blooms. A seedling tree of the yellow-fruited *Sorbus* 'Joseph Rock' was planted near the *Cytisus* to provide fall color. All of these are growing satisfactorily; the roses first flowered in 1978.

As a temporary filler we have used the herbaceous perennial *Catananche caerulea,* which grows about two feet tall and produces its blue flowers in July and August. Since slugs are attracted to the young plants, they have to be protected by regular baiting at that stage.

The more or less kidney-shaped bed (Q) was made several years earlier, about 1972. It is protected from summer sun by the old 'Seckle' pear tree to the southwest. Approximately 15 by 10 feet at the widest part, it was planned to hold the accumulating collections of dwarf conifers and ericaceous shrubs, which seem to combine well aesthetically and to grow successfully together. Three seedling *Enkianthus campanulatus* are well spaced, with single plants of *Kalmia latifolia, Rhododendron albrechtii, R. quinquefolium, R. roseum,* and *R. vaseyi* from North Carolina. There are several dwarf species of the Lapponicum and Saluenense Series such as *R. fastigiatum* and *R. keleticum.* Species of *Pernettya* include *P. prostrata* with a creeping habit and black fruits which is most successful, as well as *P. leucocarpa* and *P. pumila* which are also thriving, though not yet fruiting; the former is probably a male plant. Other members of the Ericaceae are the native *Cassiope mertensiana* raised from collected cuttings, *Calluna, Erica, Leiophyllum, Menziesia* and *Pieris; Phyllodoce breweri* from California is increasing rapidly.

Conifers distributed throughout the bed include *Abies lasiocarpa,* raised from cuttings taken from a more or less prostrate plant found in the Cascade mountains in Washington, *A. balsamea* 'Hudsonia,' and two compact dwarf forms of the Norway spruce *(Picea abies).* The very pleasing mat-forming *Tsuga canadensis* 'Cole's Prostrate' is one of the best of its type. The native *Rubus lasiococcus* was introduced as a ground cover and has now travelled over almost the entire bed except for the southwest corner which is occupied by a mat of *Polygonum vaccinifolium,* valuable for its very late spikes of pink flowers in October as well as its carpeting habit. On the east edge of the bed we have a young tree of the hybrid flowering cherry 'Accolade' *(Prunus sargentii* × *P. subhirtella),* which has already shown us the quality of its single pink flowers in April; quantity will come later.

Down the north side of the orchard area runs a series of three beds, each about 30 feet long by 8 feet wide, with a grass walk which is partly overhung or shaded by various trees for much of its length. It leads down to the northeast corner of the house where its whole length can be viewed from a large window. The easternmost bed (R) contains a fair-sized tree (about 27 feet tall) of the Whitcomb cherry (*Prunus subhirtella* 'Rosea') which was deprived of two of its three main branches by the heavy wet snow of December 26, 1976. It now continues a somewhat precarious existence although the wound is healing well. A few feet west of it is a hybrid *Catalpa* tree, a little shorter but distinctly wider than the cherry, which is a decided asset to the garden in July when it produces a bountiful crop of showy white flowers spotted with orange. Beneath these trees are young plants in temporary nursery rows. The *Catalpa* supports a plant of the Himalayan musk rose *(Rosa moschata)* which has never flowered, no doubt because there is too much shade from the large 'Yellow Transparent' apple tree directly south of it. Just beside it, at the west end of this bed, is a good example of a dwarf form of *Cryptomeria japonica,* probably 'Nana' or 'Bandai sugi,' now about 4½ feet tall and slightly wider. Behind it grows one of our favorite bush roses, 'Fantin Latour,' some five feet high, which blooms in early June with a succession of sweet-scented pale pink double flowers.

Between this and the next bed (S) is a seedling crab apple of the Siberian type *(Malus baccata),* about 20 feet tall, whose white flowers in spring are succeeded by small yellowish fruits in September and October; it is not one of the best at either season, but provides some food for birds and squirrels in the fall. The principal feature in the center of the second bed is a vigorous plant of the Japanese dogwood *(Cornus kousa)* now over 25 feet tall, upright in habit, which now blooms freely almost every summer and often has a crop of its red raspberry-like fruits in September, followed by dark red fall leaf coloring a month or more later. This is certainly one of our most indispensable plants. Neighbors to it are three species of *Euonymus* shrubs, of which the Asiatic *E. alatus* becomes the most conspicuous plant in the garden for a week or so in October when the leaves turn fiery red. *E. latifolius,* from southern Europe, is grown for its large fruits; *E. phellomanus* from northern China is a recent addition. In front of the dogwood is a large specimen of the lemon-yellow broom, *Cytisus scoparius* 'Kirkland,' found within the Kirkland city limits about 1950; the flowers are much more pleasing in their color than the normal golden-yellow type. There are two junipers near the sunny southwest corner of this bed — the glaucous gray *J. squamata* 'Meyeri' and a semi-prostrate, spreading form of *J. communis* received as 'Hornibrookii.' The latter may not be correctly named since Murray Hornibrook described his plant from western Ireland as a "perfectly prostrate mat, flowing down over rocks..." The front edge of this bed is planted with a variety of sedums and sempervivums, well able to tolerate the sunny site and dry conditions.

Some 20 feet north of this bed stands a pair of native madrona trees *(Arbutus menziesii)* which we planted about three feet apart in one hole, probably in the spring of 1953. The larger is now an erect tree of about 50 feet; the smaller is curved and leans away from the other. Because both now flower and fruit regularly, we hope that before long there will be others arising around them since there is only one other on the property — a natural seedling growing amongst the other native trees on our north lot where it has had no chance to develop properly.

A grass path several feet wide separates this bed from the next one to the west; at the back of it is a small 'Yoshino' cherry and a native mountain maple (*Acer glabrum* var. *douglasii*). Behind them is a bird-sown tree of the European hawthorn *(Crataegus monogyna)* 18 feet tall, which flowers and fruits heavily in most years and is an attraction for both birds and squirrels in September and October.

Across the wider grass walk to the south is a healthy 18-foot *Liquidambar styraciflua* (sweet gum), planted for fall color about 10 years ago. West of it is an older plant of *Viburnum* × *bodnantense* 'Dawn' (11 to 12 feet) whose flowers in November and December are often caught by frosts. The strictly erect habit of this shrub makes it difficult to place effectively; it needs to be seen from above and to have a dark evergreen background. Below it is an interesting and unusual species of maple brought from Japan by Roy Davidson in 1969, *Acer crataegifolium,* which is one of the smaller types, upright in form, with striped bark, slender branches, and acuminate leaves 2½ to 3 inches long which change to pale yellow in fall. It is now 10 feet in height and growing well. Just south of it is a columnar gray form of Port Orford cedar *(Chamaecyparis lawsoniana),* 24 feet tall, brought back from southwest Oregon in the 1950's as a seedling.

The bed (T) contains a strong young tree of the California laurel *(Umbellularia californica),* now 21 feet, also obtained in Oregon at the same time. It flowers and fruits annually, but in time it will

Blush-pink flowers of the rose, 'Fantin Lantour,' blooming in June. Photo: Brian O. Mulligan.

become as large as those in the Arboretum. The strongly scented foliage is pleasant to some visitors but not to everyone's liking. At the rear of this border is an *Ilex* × *altaclarensis* 'Camelliae-folia' with very glossy spineless leaves and a good crop of red fruits in most years; the handsome white-flowered *Camellia japonica* 'Finlandia,' a gift from Helen Buzard, is now 10 feet tall.

The front of the bed is filled with evergreen azaleas — the white *Rhododendron mucronatum (Azalea ledifolia),* its variant 'Sekidera' which has an attractive pink blotch in the flowers; and above and behind them the bright red 'Eddy.' The whole group makes a very attractive picture when they flower in May. Blooming a little earlier is the single form of the golden-flowered *Kerria japonica.* In August *Clethra fargesii,* a Chinese species, displays the racemes of white flowers typical of this genus, although they are not particularly fragrant. This was a gift from Pat Ballard's garden in 1966.

Across the walk several ferns are growing successfully under two old cherry trees. Ferns are a specialty of Margaret's and a considerable proportion of them have been raised here from spores. In this particular site we have deer fern *(Blechnum spicant);* the Japanese *Athyrium iseanum* 'Pictum' (from spores); *Woodsia polystichoides;* the climbing *Lygodium palmatum* from the eastern United States scrambling up *Pieris formosa* var. *forrestii,* and our native alpine lady fern *(Athyrium distentifolium)* found both in the Cascades and Olympic ranges. Under the north tree are *Athyrium filix-femina* 'Cristatum' and 'Victoriae,' *Dryopteris filix-mas* 'Polydactyla' with crested and divided frond tips, and the Christmas fern of the eastern United States, *Polystichum acrostichoides.* All of them seem to be quite happy in this shaded position, which is somewhat dry although regularly watered in summer.

The small border on the north side of the barbecue is also devoted to ferns. At the back are two species of *Osmunda, O. cinnamomea* and *O. claytoniana,* and a large *Dryopteris* of uncertain identity but perhaps the native *D. arguta.* In front of them are several species of *Adiantum* such as *A. monochlamys, A. hispidulum* and forms of *A. raddianum* which are not hardy here and have to be wintered in the greenhouse. Both the normal tall and the very dwarf form of *A. pedatum* are here, as well as the European hart's tongue fern *(Phyllitis scolopendrium)* and our native holly fern *(Polystichum lonchitis).*

Against the east wall of the house (U) in the south angle of the chimney is a plant of *Cotoneaster pannosus* from southwest China whose small leaves are white beneath and whose bright red fruits mature late in the fall. *Hydrangea petiolaris* climbs up the wall to and over the chimney from which it has to be annually removed but where it flowers profusely. One of the best double pink forms of *Camellia japonica,* 'C.M. Wilson,' which has double pink flowers, is now 12 feet high against the north side of the chimney. North of it *Camellia sasanqua* 'Hiryu' has small red single flowers, but blooms too late in the season (December) and too sparsely to be effective.

Finally at the north end of the house a carefully pruned yew acts as a windbreak. The front of this short border is planted with *Viburnum davidii* and the white-berried form of *Skimmia japonica,* plus one male plant of the latter for pollination.

The shady north side of the 1958 extension is overhung by the projecting eaves. Here grow mature specimens four feet tall of two kinds of sweet box (*Sarcococca ruscifolia* and *S. confusa*) which seem well suited to this sheltered location, particularly since the former has been cut back in some of our colder winters. Both flower freely in February and produce quantities of red or black fruits respectively which take a full year to ripen. Beside the latter is a 4½-foot wide patch of *Adiantum venustum,* a Himalayan fern which seems to be quite hardy here, even though the foliage turns brown in winter. Adjoining it is a mat of our native evergreen *Rubus nivalis* from the foothills of the Olympic mountains; this can be recommended as an attractive ground cover, even though it flowers but rarely.

This border continues west along the original house for more than 20 feet and is 3½ to 4 feet wide; it is filled principally with ferns of all sizes, types and habits, from tall species of *Polystichum* and *Asplenium,* the shiny-leaved *Dryopteris erythrosora* from Japan, mat-forming *Blechnum penna-marina* from New Zealand, and three natives of this state: *Polypodium scouleri* from the coast, oak fern *(Gymnocarpium dryopteris)* from deep woods, and the northern beech fern *(Thelypteris phegopteris)* from the Cascade mountains. A few other plants find a home here among the ferns: some *Shortia* species; a

well-established mat of the creeping *Fuchsia procumbens* from the North Island of New Zealand, which bears its pink fruits annually here; and a charming form of *Tiarella cordifolia,* var. *collina,* with pale pink flowers, which we obtained from George Schenk. A narrow tree of Port Orford cedar grows against the northwest corner of the house shutting off the wind from this quarter.

The area to the north of the house (V) was originally planted with some raspberries which we removed after a few years of unsatisfactory cropping. Now it contains a number of trees and shrubs that needed permanent homes. A vine maple grows towards the center and a subalpine fir *(Abies lasiocarpa)* near the north corner. A plant given us by the late Mrs. O.B. Thorgrimson as a *Stewartia* species proved, when it flowered, to be the Asiatic sweetleaf *(Symplocos paniculata).* Now about 10 feet high, it bears clusters of small fragrant white flowers in May, usually succeeded by a number of deep blue, berry-like fruits in September and October; it is a valuable two-season shrub for this area.

On the east side there is a 16-foot specimen of a true species of *Stewartia* acquired as *S. pseudocamellia.* The source is unrecorded, but possibly it came from the late Carl S. English, Jr. This plant has recently been identified as the Chinese *S. rostrata,* which was only so-named as recently as April 1974 by Dr. S.A. Spongberg of the Arnold Arboretum in Boston. How our plant reached this area is at present something of a mystery, since this is the first record of its occurrence on the Pacific coast, although it has been grown for some years in several arboreta in the eastern United States. The white flowers, which open widely in June, are similar to those of *S. pseudocamellia* (or of var. *koreana*); the dry capsules with their pointed beaks remain on the tree throughout the winter. However, the leaves are more elongated and undulated along the margin, and the bark is finely striated and does not flake or peel off as in the other species.

Nearby, at the southeast corner of the bed, is a good specimen of the weeping or prostrate form of Norway spruce (*Picea abies* 'Reflexa') which covers the bank most satisfactorily. Other spaces are filled by several kinds of smaller rhododendrons, including *R. mucronulatum* with its welcome early purple flowers. There are also deciduous azaleas that bloom in May, and *Leucothoë* and salal *(Gaultheria shallon)* to cover the ground and smother weeds. The southwest corner is marked by an old plant of the intergeneric hybrid *Gaulnettya wisleyensis (Pernettya mucronata* × *Gaultheria shallon),* now four feet in height, which flowers and bears fruits every year. For low ground covers we have *Epimedium perralderianum* which is evergreen, and the deciduous, white-fruited form of the alpine strawberry which spreads rapidly by runners.

The recess to the north of this bed is marked at its entrance on the right side by a fine example of the hybrid *Hamamelis* × *intermedia (H. mollis* × *H. japonica),* now 15 feet wide by 8 feet high. This came from the former Bonnybrook Nursery near Bothell; it not only flowers profusely with lemon-yellow blossoms in February but also changes to a rich red color before the leaves fall in late October. We would like to propagate this plant to see whether this character is inherited or due to our soil and site conditions. Above it is a young 30-foot tree of the purple-leaved sycamore maple (*Acer pseudoplatanus* 'Purpureum') which came from the same nursery. We were fortunate in this combination planting since it, too, is conspicuous for its orange to red fall leaf color.

On the left side is a large multi-stemmed specimen of *Parrotia persica* (24 feet), also belonging to the Hamamelis family and planted for its fall coloring, since the reddish flowers in early spring are hardly noticeable. At the end of the grass walk beside the bench a Chilean firebush *(Embothrium coccineum)* has been growing for perhaps 20 years, but probably because of the shade from surrounding evergreen trees has only flowered occasionally and then sparsely. Now that it is becoming larger, perhaps it will do so more freely. A much younger shrub of *Stachyurus praecox* hangs over the east end of the bench and produces its interesting pale yellow tassels in spring. Behind it, on the edge of the woods, are several bird-sown young trees of our native dogwood, just old enough to flower regularly.

The lower bed (W) is now well filled with a varied assortment of small trees and shrubs that give us year-round interest. It is dominated first by a vigorous young tree of the evergreen *Nothofagus dombeyi* from Chile, now about 35 feet high and growing several feet each season; secondly by a very large old plant of *Magnolia sieboldii* (12 by 20 feet wide) on the south side nearest the house. It blooms generously in May

and early June each year but has never produced any fruits despite frequent attempts to hand-pollinate it. Under its shade is another planting of Margaret's ferns, since the site is damp much of the year. These include a group of the ostrich fern *(Matteuccia pensylvanica),* the common polypody *(Polypodium glycyrrhiza),* and a large specimen of the native *Polystichum andersonii* which thrives here.

At the northeast corner of this bed three conifers help to form a background for other deciduous shrubs, namely the light green *Picea glauca* 'Conica' (9 feet), an upright gray-foliaged form of *Juniperus virginiana* (20 feet) and the more bushy and silver-gray *Chamaecyparis pisifera* 'Boulevard' ('Cyanoviridis') (10 feet). In front of the juniper is one of the most pleasing plants in the garden at all seasons, *Acer japonicum* 'Aconitifolium' (11 feet), which we enjoy for its lovely young foliage in spring, rich red leaf color in October and the strong branch structure in winter. The foreground is occupied by azaleas and smaller types of rhododendrons blooming in April and May, except for the June-flowering *R. viscosum* with its sweetly-scented tubular white blossoms.

Other smaller trees planted at the rear include another *Embothrium* (15 feet) which does bloom regularly each summer although its stems have been damaged by some of our colder winters; *Cornus florida* (19 feet), making a real tree now and blooming heavily in May; *Acer palmatum* 'Sangokaku' (16 feet), the red-twigged form of the Japanese maple most conspicuous in late winter. Near the lower west end of the border is a flourishing young Chinese birch, *Betula albosinensis* var. *septentrionalis* (20 feet), raised from seeds received from a Scottish garden in 1963. This is another plant valuable for its winter appearance, having pale brown bark peeling off to reveal a whiter surface beneath; there are two older specimens on the east side of Azalea Way in the Arboretum, amongst the *Ceanothus*.

The west end of our border is completed with a group consisting of *Magnolia stellata,* flowering in April, *Deutzia vilmoriniae* with snow-white inflorescences in May, *Cotoneaster lactea* flowering in June and bearing a heavy crop of welcome bright red fruits in December, if the robins do not take them earlier. Between these and the *Magnolia sieboldii* is an assortment of herbaceous plants grown for their foliage effects—glossy green *Bergenia purpurascens* 'Ballawley,' *Hosta sieboldiana* with its very broad glaucous leaves and rather insignificant flowers; behind them is the much taller *Peltiphyllum peltatum* from southern Oregon and northern California, shooting up heads of pink flowers in spring followed later by the big shield-shaped leaves. This moist situation agrees well with all of them.

The site of an old well (X), is covered completely by the European honeysuckle, *Lonicera periclymenum,* with quantities of sweet-scented flowers in June — fit companions in a vase for the rose 'Fantin Latour' which blooms at the same time. At its southwest corner is a young tree of the western larch *(Larix occidentalis)* planted in 1969 to help hide the nearby power pole.

This concludes a tour around our garden, for the plantings on the west front of the house were described in the previous article.

In conclusion it may be said that despite or perhaps because of being inveterate collectors of plants, we have tried to find and use as wide a selection of good quality or interesting plants of all kinds as possible. These range from rock-garden dwellers to trees which will give us something to look at and enjoy through most of the year in our climate. We have tried to find the right places and conditions to suit their needs. Perhaps the conifers and winter-flowering shrubs have received especial emphasis since the dreariest months of the year are from November to February in the Puget Sound region. Summer flowers have not received as much attention except for the heathers and a few herbaceous species such as *Echinops, Inula, Catananche, Kniphofia* and *Verbascum*.

It should also be noted that in a garden as closely planted as this one, it is essential to prune regularly and sometimes severely to prevent some plants from overgrowing others more valuable or smaller, and even to remove some of them for the benefit of others. The only kind of fertilizer used here, apart from that for the fruit trees each fall, is some dried cow or sheep manure on the beds each spring. Many of the smaller ericaceous and other shrubs have been and are propagated regularly each year for local plant sales of various groups and societies in order to distribute them more widely to amateur growers, and this we shall continue to do as extensively as possible. ▲

Photo: Brian O. Mulligan.

Young leaves of *Acer japonicum* 'Aconitifolium' in the garden of Brian and Margaret Mulligan.

Book Reviews

JAPANESE MAPLES, by J. D. Vertrees. Timber Press, Forest Grove, Oregon. 9½ × 12, 178 pages. Price $39.95.

Many superlatives would be justified in the description of this magnificent volume, not only alone for the very generous number of attractively composed color photographs, but equally so for the comprehensive chapters on taxonomy, culture and propagation. Many facts, hitherto only contained in technical literature and rare publications, have been collected and presented for the first time to the maple enthusiast.

Presenting the views based on studies by certain taxonomists, Mr. Vertrees lists the taxonomic subdivisions of the Japanese maple: Palmatum, Amoenum and Matsumurae. Examples of named cultivars for each subdivision are included. Current taxonomic studies have been based on leaf structure, seed type and bud scales. Research to determine species status is still very much in the formative stages, involving studies of chemistry, floral components and cellular structure. In comformance with most taxonomists, Mr. Vertrees leans toward the combining of these (tentative) subdivisions under the one heading of Palmata, treating Amoenum and Matsumurae as subspecies.

Culture

The wealth of information in the chapter on culture is extraordinarily broad. This should be required reading for every nurseryman, landscaper and garden maintenanceman. The selection of site, exposure, soil mix are carefully detailed. Choice of leaf color and leaf structure is an essential, understood by few, in locating these beautiful trees in the landscape.

An important point is made in the choice of fertilizers under some extreme acid soil conditions experienced in the Northwest landscape. The use of ammonium forms of fertilizers is to be avoided. Non-ammoniums such as calcium nitrate are suggested as a better choice.

Water management is carefully covered. One of the major contributing factors associated with Japanese maple tree failure, especially in the Dissectum group, is moisture—the lack of it or wrongly applied, often resulting in the loss of the plant, leaf scorch or leaf loss. The physiology of leaf coloration is interpreted; in simple terms, the withholding of water in late summer, thus placing the tree under slight stress and inhibiting chlorophyll production, enables the latent color-forming pigments to express themselves.

The section on pruning perhaps covers one of the least understood essentials of Japanese maple culture. Seeing these trees growing in the wild and subjected to the vagaries of nature, one often observes specimens of great beauty. When grown in protected areas of home gardens, in rich soils and with excessive water, they lose their wild artistic character and take on the appearance of a neglected overgrown shrub. Shaping, pruning, containing the tree to manageable size — to accentuate the natural grace of its horizontal limb structure — brings out the ultimate beauty of these trees. Special treatment of the Dissectums is stressed. The elimination of bushy undergrowth reveals the attractive natural contortions of the limbs, so typical in these forms.

Pests and problems are given due attention, with good coverage of aphids, mites, worms, beetles. Root weevils are treated in length since these are so prevalent in the Northwest, though not too serious a threat to maples. Other problem areas include the verticillium wilts, sometimes a serious disease in maples. Fusarium, botrytis, anthracnose, chlorosis and other miscellaneous problems round out this chapter.

Propagation

Personal experiences in seed handling are revealed. The tendency for most maple seed to be shortlived, time to pick seed, double dormancy, erratic germination, seed-chilling temperatures during stratification and storage, planting media, direct outside and seed-flat sowing, seedling transplanting, rate of first year growth, potting up, summer growing on and hardening off — all these are carefully gone over.

Controlled and natural methods of hybridization are reviewed. The finding of many outstanding seedlings, particularly the red forms, from various crosses is mentioned. The opinion is expressed that distinct opportunities exist to develop worthwhile forms by crossing cultivars within the Palmata series. Crosses are also recommended between *A. palamatum* and such species as *A. pseudosieboldianum, A. shirasawanum* and *A. circinatum.*

Grafting is the chief method of propagating cultivars. In this chapter, the techniques of timing are given — in the United States, January to March and October to November; in Holland, July; in Japan, January or February. Age, type and preparation of understock, temperature, condition and treatment of scion wood are just a few of the requirements discussed. The cambium is given special attention, with an analogy to simplify understanding. Precise mechanics of the grafting procedure are provided, including after-treatment. Comparison is made between European and Japanese methods. Special methods of scion placement for special effect, plus other techniques are covered. This is a most important chapter for the propagator. All methods and associated data are covered in great clarity and detail.

A method of vegetative propagation by rooted cuttings is in use to a limited degree, successful only with certain cultivars. Semi-hardwood cuttings taken in early summer, inserted in various combinations of peat, perlite, sand, under mist, is the principal method. Special problems associated with this technique are taken into account.

Layering, an old-time, seemingly simple method of increasing stock is also treated.

The cultivars displayed

This portion of the book, including many close-up detail photographs of good quality, describes particulars of approximately 228 *Acer palmatum* cultivers. These are separated into eight groups: 1) palmate leaves, 2) dissected leaves, 3) deeply divided leaves, 4) linearilobed leaves, 5) dwarf forms, 6) variegated leaves, 7) unusual features, 8) new hybrids. This is followed by the *Acer japonicum* section, where 21 cultivars are listed. Regrettably this beautiful species is largely overlooked by most growers. Offering attractive limb structure, dependable fall color and slow growth, these trees are especially suitable for the small garden. In the final part of this section, other Acer species of Japan are described and illustrated. These included the outstandingly beautiful *A. buergerianum; A pseudosieboldianum, A. sieboldianum* and *A. shirasawanum,* and the very rare *A. pentaphyllum.*

Though not of recent oriental origin, *Acer circinatum* is included because of its botanical relationship to the Far Eastern species. Illustrated, perhaps for the first general public viewing, are several cultivars of this tree, chiefly the variety 'Monroe' with 'multi-dissected' foliage, which appears to be especially attractive. The fascinating theory expressed by some authors is that *A. circinatum* migrated from the Far East via the one-time bridge across the Bering Straits.

In the description of these trees, Mr. Vertrees provides us with more than the bare factual dendrological details. He includes leaf color in all seasons, historical background where known, growth habits and landscape use. A special section provides details to assist in the selection of these cultivars for special use. Thus, one may choose specific forms for use as bonsai, for special effects, full sun, partial shade, et cetera. Translation of Japanese names used to describe many of the cultivars is also given.

It is hoped that at some future time, this book will be re-issued in reduced size with pliable waterproof jacket for use in the field. *MILTON GASCHK*

HYBRIDS AND HYBRIDIZERS, Rhododendrons and Azaleas for Eastern North America. Edited by Philip A. Livingston and Franklyn H. West. Harrowood Books, Newtown Square, Pa. 1978. Price $30.

The introduction of rhododendrons at the 1978 Centennial Exposition certainly started something in the United States. Unfortunately, a large part of this nation was unsuitable for growing the most beautiful of these plants. About 50 years ago, a few inquisitive men with very diverse backgrounds, dissimilar personalities and differing economic circumstances began working individually on extensive programs to breed rhododendrons. Their goals included the development of large-flowered plants which could thrive in the rigorous climate of the eastern section of the United States. Then years of patient crossing and re-crossing were required, followed by the raising of thousands of progeny from which they selected only the finest clones. That these early hybridizers were successful in reaching their goals is proven by the necessity for a book such as this one.

The first five chapters paint for us the story of five of these pioneers, their history and personal adventures. Letters, speeches and testimonials are reprinted. Color pictures illustrate some of their best shrubs produced through their intelligent decisions and meticulous, hard work.

Charles O. Dexter a prosperous textile manufacturer bought and restored an abandoned farm in Sandwich, Massachusetts. He began hybridizing rhododendrons in 1921 at age sixty-nine. His Shawme Farm is now the Heritage Plantation and its present owners maintain a large collection of Dexter's most satisfactory hybrids. Included here is an interesting account of the search being made by a dedicated informal group of men for the scattered and "lost" Dexter hybrids.

Joseph B. Gable of Stewartstown, Pennsylvania, turned from farming to become a nurseryman. This change led to more than 40 years of enthusiastic work breeding tough and colorful rhododendrons. His story is one of family encouragement and persistence. His letters abound with information.

In 1916, Benjamin Y. Morrison made a trip to the Orient and while in Japan, he observed the splendid hybrid azaleas being grown there. Perhaps he stored these memories, for some time later while working for the Department of Agriculture he became involved fully in the creation of large-flowered azaleas that could withstand the climate of Washington, D.C. By 1930-40, his first introductions were ready for distribution. Many more were to come. Even in retirement this extremely talented man was not through with hybridizing. He continued work at Pass Christian, Mississippi, developing the Back Acres strain of azaleas.

Another man of immense and varied talents is G. Guy Nearing. When doctors advised him to pursue outdoor activities, after due consideration, he chose the nursery business. More than his share of calamities have befallen his enterprises over the years. Eventually, he built a successful nursery at Ramsey, New Jersey, but in 1945 a disastrous flood destroyed it and the hybrids of ten years' labor. He began again. Along the way, he invented new propagation devices that are in common use throughout the country.

Anthony M. Shammarello worked hard assisting his father in a landscape and nursery business, but his major breeding program grew out of disaster. An exceptionally cold winter struck northern Ohio in the 1938-39 season. Even some of the so-called ironclads were frozen to the roots. Using the survivors, Tony Shammarello resolved to create rhododendrons that would be attractive and completely hardy. Years passed as he patiently crossed and selected hybrids, which are growing today in widespread areas of the United States and abroad.

It is high time, indeed, that an account of the efforts and struggles of our early hybridizers and propagators be recorded before they are forgotten. Their work is the basis for future improvements.

This book is more than a group of enjoyable biographies. It has lists and information compiled to guide us in the selection of contemporary hybrids, zone maps, quality ratings and names and descriptions of the rhododendrons and azaleas created by each of these five pioneers. It is a thoroughly interesting and highly informative book. *GWEN BELL*

Announcements from the Unit Council

Four Unit Council meetings are held each year, on the third Thursday of September, November, March and May. The dates for upcoming meetings are March 15 and May 17, 1979. The meeting place is St. Stephen's Episcopal Church in Laurelhurst; the time is from 9:30 a.m. until 12 noon. Unit chairmen are invited to attend with one or two unit members in order to keep informed on Arboretum activities.

Bulb Sale Chairman, Jeanne Gardiner, reports a preliminary gross profit from the 1978 Bulb Sale of $15,000. Indian summer weather on sale days made the trip to the Arboretum memorable for people from as far away as Minnesota, Idaho, British Columbia and Oregon. The unusual variety and high quality of bulbs offered has attracted buyers who anticipate this opportunity to plant the unusual spring flowering bulbs. Many memberships in the Arboretum Foundation result from this association with the Arboretum.

Unit members are reminded that membership requires *paid-up dues* in the Arboretum Foundation and are urged to send in their dues for the current year.

Louise Czerniski, Education Chairman, reports full enrollments in the classes on Botany, Bonsai and Greenhouse Management. A spring session of the Botany class may be held if sufficient interest is shown. Those interested should call the Foundation Office, 325-4510. The Bonsai Class, taught by expert Connie Raphael, will continue through spring, one section on Mondays, one section on Tuesdays.

The Flower Show chairman is Ruby Williams. The exhibit will be held at the Museum of History and Industry on March 29 and 30, 1979. Participation by all units is welcomed. This second annual show is intended as an opportunity to share, on a non-competitive basis, the blossoms and foliage of plant materials from indoors and out. Individual Arboretum units will display their members' floral specimens in innovative arrangements on separate tables. Accurate labeling will be encouraged and cultural requirements will be shared.

The Explorers' Walks have proved so popular that an additional one was scheduled in early November, and there will be a December walk on the 27th (the fourth Wednesday). Walks in January and February will be on the fourth Wednesday only. As of press time an extra walk in March has not been scheduled, but those who are interested in one may call the Foundation office. These walks are open to the public and begin at 10 a.m. at the Arboretum Office. They are guided tours of those parts of the Arboretum which are most attractive at that particular time.

New units are being formed: one on Mercer Island, No. 95, for beginning gardeners; and one in Bremerton, an outgrowth of participation in the Explorers' Walks. Those interested in joining these new units should call Doris Taggart, 822-0412. *PAT MONCINI*

Unit Council Governing Board

Officers — General Chairman, Mrs. Daniel H. Coleman (Sally Sue). 1st Vice-Chairman, Membership, Mrs. Raymond Taggart (Doris). 2nd Vice-Chairman, Education, Mrs. Fred Czerniski (Louise). 3rd Vice-Cochairmen, Greenhouse, Mrs. James Andersen (Barbara) and Mrs. J.R. Sambrook (Mary); Assistant, Mrs. R.H. Nichols (Marilou). Secretary, Mrs. Lucien Moncini (Pat); Assistant, Mrs. Sharon Goedecke. Finance, Mrs. C.E. Simons (Carol). Past General Chairman, Mrs. Fred G. Clarke, Jr. (Lee).

Committees — Honorary, Mrs. Donald Graham (Juanita). Community Services: Hospitals, Mrs. Donald Hochberg (Joanne); Nursing Homes, Mrs. James Level (Virginia); Schools, Mrs. George Frazier (Vera). Guide Programs: General Arboretum and Native Guide Chairman, Mrs. Allen D. Moses (Elizabeth); Arboretum Guide Scheduling, Mrs. William Ford (Barbie); Native Guide-Foster Island Scheduling, Ms. Lois Frayser; Native Guide Training, Mrs. David A. Taft (Sheila); Japanese Garden Guide Training, Mrs. T.A. Rathje (Evelyn); Japanese Garden Guide Scheduling, Mrs. John Halloran (Darcie). Herbarium, Mrs. Gayton S. Bailey (Bettina). Horticulture, Mrs. Brian O. Mulligan (Margaret). Hospitality, Mrs. James Horrigan (Helen). Research, Mrs. Gordon Mulder (Mary Ellen). Sales: Plant Sale, Mrs. Dean Wilson (Suzanne); Bulb Sale, Mrs. Arthur Gardiner (Jeanne); Bulb Sale Assistant, Mrs. N. Stewart Rogers (Jane). Slides, Mrs. Clifford Eckman (Carol). Unit Program Planning, Mrs. Clifford Jones (Judith); Assistant, Mrs. Frank Anderson (Chris). Unit Quarterly News, Mrs. Fred G. Clarke, Jr. (Lee). Work and Fun Day, Mrs. James C. Trombold (Mary Ann). District Representatives: City Wide, Mrs. Wm. L. Wilton (Peggy); East Side, Mrs. K.J. Usack (Mary); Kitsap-Bainbridge, Mrs. Philip C. Keith (Shirley); Mercer Island, Mrs. Winston Peterson (Marcia);

North East, Mrs. Kim Farwell; North Shore, Mrs. James Schilling (Marge); North West, Mrs. Jay C. Michel (Jeannette); South End, Mrs. Stephen Thomas (Lori); West Seattle, Mrs. F.H. Bell (Gwen).

In addition we wish to call attention to Dora Murphy's contribution as leader of the Explorers' Walks. Our "Book Lady," Loretta Slater, from whom Foundation members can purchase or order books at a 10 percent discount, can be reached at 232-0456.

New Members of the Arboretum Foundation

We are pleased to welcome the following new members (July 1, 1978 through August 31, 1978):

Sustaining—Marsha Wolcott. *Annual*—Virginia B. Adams, Marvin Black, Thomas Brewer, John Brown, Mrs. Diane Crummett, Mr. and Mrs. George Duecy, D.R. Edwards, Mrs. Richard Fellows, Martha French, Timothy J. Geyer, Lewis Jacobs, Mrs. Wm. F. Kraus, Mrs. Robert Lindberg, Richard W. Mathas, James Matthews, C.M. McCune, Robert Piper, Creta S. Pollock, James Raisis, H.J. Suckling, Gerald Tucker, Van Dusen Garden Library, Lois Watson, Allan Wing, Mrs. John Wolcott, Phillip Young.

We are also grateful to the following who have increased their dues to: *Supporting*—John Robertson.

University of Washington Classes

Spectrum, the quarterly journal for Continuing Education, is sent free to those who have indicated interest in the University of Washington's night courses, adult education classes, concerts and other cultural activities. Those who wish to obtain early notice of such classes and registration forms are urged to place their names on the mailing list by calling 543-2590.

Arboretum Courses

WINTER IDENTIFICATION OF NATIVE TREES AND SHRUBS. Field class covering 40 species of common trees, shrubs and ferns native to western Washington. Instructor: Carla Culver. Class limited to 15; meet at Arboretum office. Saturdays, Feb. 3 thru 24; 10-12. 4 sessions, $10.

BIRD IDENTIFICATION FOR BEGINNERS. Merilyn Hatheway, experienced birder, will conduct a field class on land birds commonly found in the Arboretum and waterfowl on Lake Washington. Binoculars required; appropriate clothing and boots recommended. Class limited to 15; meet at Arboretum office. Saturdays, Jan. 20 thru Feb. 24; 9-11. 6 sessions, $15.

WINTER PROPAGATION. Mr. Richard van Klaveren, Arboretum propagator, will teach techniques for propagating woody plants, including cutting and seeding. Materials and plants furnished. Arboretum greenhouse; class limited to 15. Saturdays, Jan. 27 & Feb. 3; 9:30-12 noon. 2 sessions, $12.

GRAFTING ORNAMENTALS. Mr. van Klaveren will instruct in techniques for grafting woody plants. Materials and plants furnished. Arboretum greenhouses; class limited to 15. Saturdays, Feb. 10 & 24; 9:30-12 noon. 2 sessions, $12.

HOUSE PLANTS. Mr. van Klaveren will discuss indoor plants. Topics covered include identification, techniques of propagation and care. Materials and plants furnished. Arboretum greenhouse; class limited to 15. Saturdays, Mar. 17 thru 31; 9:30-12 noon. 3 sessions, $15.

BASIC GARDEN MAINTENANCE. Mr. Chico Narro, expert nurseryman, will teach a class on basic gardening techniques. Included are soil preparation, planting, fertilizing, mulching, pruning and seasonal care of plants. Class limited to 15; Arboretum greenhouse. Saturdays, Feb. 10 thru Mar. 17; 1:30-3:30. 6 sessions, $15.

PRUNING ORNAMENTALS. Mr. Narro will demonstrate techniques of pruning trees and shrubs. This is an outdoor demonstration class; appropriate clothing and waterproof footwear are recommended. Class limited to 30: meet at Arboretum greenhouse. Saturdays, Mar. 24 & 31; 1-3. 2 sessions, $5.

For further information, call 543-2730. To register, make check payable to the University of Washington and send to: Arboretum Courses, Anderson Hall (AR-10), University of Washington, Seattle, WA 98195.

Continuing Education

THE ARCTIC, a Saturday program. The arctic—that most inhospitable of domains—is one of the most interesting yet least understood areas of the earth. Speakers will be: Lawrence Bliss, Professor and Chairman of the Botany Department, program coordinator; Stephen Porter, Professor of Geological Sciences; Fiorenzo Ugolini, Professor of Forest Resources; John Edwards, Professor of Zoology. Saturday, February 24; 9 a.m.-5 p.m. $15 ($10 for high school and college students with I.D.).

SCIENTIFIC DRAWING. Instructor: Phyllis Wood, scientific illustrator, Health Sciences Illustration. Mondays, Jan. 8-Mar. 19; 7-10 p.m. 10 sessions, $40.

To register, call the Office of Continuing Education, 543-2590.

CALENDAR OF EVENTS

Arboretum Foundation:		Regularly Scheduled:	
Board of Directors	December 7	Greenhouse Day	Every Tuesday
	March 8	The Mae Granston	
Executive Committee	January 11	Rhododendron Study Group	1st Monday
	February 8	Herbarium Committee	1st Friday
		Northwest Natives	
Unit Council:		Study Group	3rd Monday
Unit Council Meeting	March 15	Rock Garden	
Governing Board	January 4	Study Group	3rd Wednesday
	February 1	Arboretum Explorers	4th Wednesday
	March 1		

The Politics of Trees, a one-day symposium, January 26.
See page 9.

Landscape Design, a "how to" course by Glen Hunt:
February 8 thru March 15, 7:30-9:30 p.m.
Pacific Science Center

Northwest Ornamental Horticultural Society Programs:
February 8 & March 8 at 11 a.m.
Museum of History & Industry.
For information about the above items, see Special Programs, page 26.

Unit Council Flower Show: March 29 & 30.
Museum of History & Industry.

Work and Fun Day: April 12. Arboretum Foundation Plant Sale: May 2 & 3.

FOR INFORMATION, CALL 325-4510

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Bare branch against a winter sky. **Photo: Nancy Walz.**

VISIT THE ARBORETUM THIS WINTER.

Bare branches are decorative, too.

The garryas bloom in January and February. Other early blooming plants may be found in the Winter Garden, the camellia and witch hazel collections.

For their locations
obtain the catalogue of woody plants at the Arboretum office.
Paperback — $4.75; Hardback — $8.50.

Join the Explorers' Walk every fourth Wednesday including December this year: December 27, January 24, February 28 and March 28. Meet in the parking lot of the administration buildings at 10 a.m.